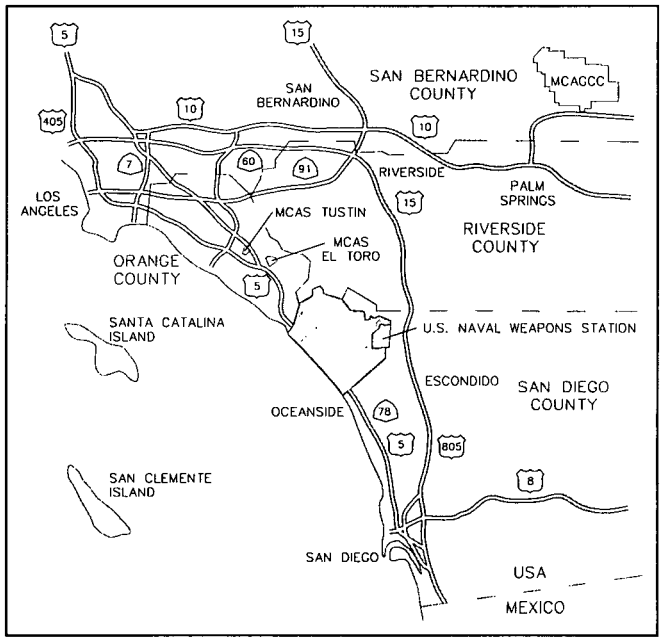
FINAL

Engineering Evaluation/Cost Analysis Non-Time Critical Removal Action for Interim Removal Action at Site 1111
Marine Corps Base Camp Pendleton, California



Prepared for

NAVFAC
Naval Facilities Engineering Command

NAVAL FACILITIES
ENGINEERING COMMAND
SOUTHWEST DIVISION
1220 Pacific Highway
San Diego, California 92132-5190

Networld Exchange, Inc. (NEI)
Contract No. NBCH0002D0037
Battelle/NEI Purchase Order No. 1323-001

by

BATTELLE
Environmental Restoration Department
505 King Avenue
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April 6, 2006

FINAL

ENGINEERING EVALUATION/COST ANALYSIS

NON-TIME CRITICAL REMOVAL ACTION FOR INTERIM REMOVAL ACTION AT SITE 1111 MARINE CORPS BASE CAMP PENDLETON, CALIFORNIA

Prepared for

NAVAL FACILITIES ENGINEERING COMMAND, SOUTHWEST DIVISION
1220 PACIFIC HIGHWAY
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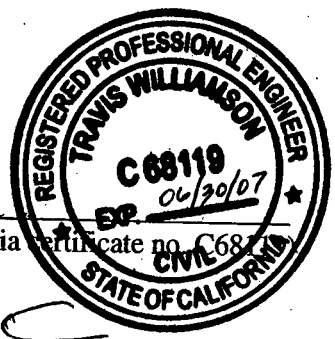

Signed: _____ Date 4/10/06
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Mark E. Kelley (Project Manager)

EXECUTIVE SUMMARY

This Engineering Evaluation/Cost Analysis (EE/CA) was prepared in accordance with current United States Environmental Protection Agency (U.S. EPA) and United States Department of Navy (DON) guidance for a non-time critical removal action under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). This EE/CA summarizes the results of the EE/CA process, characterizes the site, identifies removal action objectives (RAOs), describes removal action alternatives, contains an analysis of these alternatives, and describes the recommended removal action alternative for Site 1111, Marine Corps Base (MCB) Camp Pendleton.

Site 1111 includes a 0.12-acre area located in the southeastern portion of the base. During removal activities at the adjacent Site 3 (a former pesticide wash area) in 1997, a subsurface layer of ash and burn material was exposed in the northeastern portion of the site. Because the ash and burn material was located in an ecologically sensitive area, the removal action conducted in 1997 did not remove these soils even though the soils contained waste constituents that exceeded project removal goals. The remaining burn layer has since been designated as Site 1111. Major environmental investigations that address Site 1111 include the *Remedial Investigation/Feasibility Study (RI/FS) for OU-4* (Parsons, 1999), the *RI for Operable Unit (OU)-5 Sites 1A-1, 6A, 21, 1111, and 12 Area* (Parsons, 2004), and the *Draft FS for OU-5 Sites 1A-1, 6A, 21, 1111, and 12 Area* (Parsons, 2005).

Because the Draft FS (Parsons, 2005) already addresses Site 1111 soil and because its recommendations and conclusions have been accepted in principle by the regulatory agencies, this EE/CA draws upon the information presented therein. One significant difference between the FS and the EE/CA is that removal goals for the EE/CA have been set at levels appropriate for unrestricted (i.e., residential) land use, whereas removal goals used for the FS are for restricted land use. The FS (Parsons, 2005) is based on a restricted-use scenario; it provides risk-based concentrations (RBCs) that can serve as removal goals for an unrestricted land use scenario. Therefore, the conclusions derived in this EE/CA are based on the unrestricted-use RBCs developed for Site 1111 soils.

Site 1111 is located in the Santa Margarita River Basin, approximately 2,300 ft east of the center of the Santa Margarita River. Groundwater is present at depths of 5-6 ft below ground surface (bgs) at the site and soils consist of silty sands. Elevated levels of organic and inorganic contaminants were detected in vadose zone soils at Site 1111 during site investigation activities. The site is not currently used by the base, and it is located adjacent to a sensitive ecological habitat.

Contaminants of concern (COCs) at the site were identified based on a human health risk assessment (HHRA), an ecological risk assessment (ERA), and the leaching potential of constituents to impact site groundwater at concentrations above state and federal drinking water (beneficial use) standards. Soil COCs at Site 1111 include one dioxin, seven VOCs, two SVOCs, three pesticides, and eight metals.

The RAOs for this action are to minimize the exposure of soil constituents to human and ecological receptors and protect the beneficial uses of the lower Santa Margarita River basin. The RBCs for soil COCs serve as the removal goals (RGs) for the proposed soil removal action at Site 1111. The RAOs will be achieved by removing soils containing levels of COCs above RGs in order to eliminate the threat to human health, ecological receptors, and groundwater posed by these soils.

Eight removal alternatives were screened and evaluated for Site 1111. The options were screened based on site-specific factors, and alternatives that had limited effectiveness, implementability, or cost-effectiveness were eliminated. The initial screening process resulted in three potential removal options for contaminated soil at the site: S1 – no further action; S2 – institutional controls; and S3 – soil excava-

tion, backfilling with clean soil, and off-site disposal of the excavated soil. These three alternatives were then thoroughly evaluated based on effectiveness, implementability, and cost. The ability of the alternatives to comply with applicable or relevant and appropriate requirements (ARARs) was considered when evaluating the effectiveness of the alternatives. ARARs affecting this removal action at Site 1111 include requirements related to the Resource Conservation and Recovery Act (RCRA) and the California Hazardous Waste Act, the Clean Air Act (CAA), the Toxic Substances Control Act, the Floodplain Management Act, the Endangered Species Act of 1973, the Migratory Bird Treaty Act, and the Clean Water Act (CWA).

Based on the evaluation process for the three soil removal alternatives, the recommended removal action for Site 1111 is S3 – excavation, backfilling with clean soil, and off-site disposal of excavated soil. This alternative is effective, readily implementable, and will achieve RAOs. This option provides the greatest long-term protection of human health and the environment. It is estimated that this removal option would require one month of on-site work and cost approximately $699,000.

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FIGURES

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ABBREVIATIONS AND ACRONYMS

AM	Action Memorandum
amsl	above mean sea level
ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
CAA	Clean Air Act
Cal-EPA	California Environmental Protection Agency
CAMU	Corrective Action Management Unit
CCR	California Code of Regulations
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	contaminant of concern
COEC	contaminant of ecological concern
COPC	contaminant of potential concern
COPEC	contaminant of potential ecological concern
CWA	Clean Water Act
DCE	dichloroethylene
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
DERP	Defense Environmental Restoration Program
DoD	United States Department of Defense
DON	United States Department of Navy
DOT	(California) Department of Transportation
DTSC	(Cal-EPA) Department of Toxic Substances Control
EE/CA	Engineering Evaluation/Cost Analysis
ERA	ecological risk assessment
FS	Feasibility Study
GIS	Geographic Information System
HHRA	human health risk assessment
HpCDD	heptachlorodibenzo-*p*-dioxin
HpCDF	heptachlorodibenzofuran
HxCDD	hexachlorodibenzo-*p*-dioxin
HxCDF	hexachlorodibenzofuran
JEG	Jacobs Engineering Group, Inc.
MCAS	Marine Corps Air Station
MCB	Marine Corps Base
MDL	method detection limit
MTBE	methyl-*tert*-butyl ether

NA	not analyzed
N/A	not available
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
ND	not detected
NFEC-SW	U.S. Naval Facilities Engineering Command Southwest Division
O&M	operations and maintenance
OCDD	octachlorodibenzo-*p*-dioxin
OCDF	octachlorodibenzofuran
OU	Operable Unit
PAH	polycyclic aromatic hydrocarbon
PCE	tetrachloroethylene
PeCDD	pentachlorodibenzo-*p*-dioxin
PeCDF	pentachlorodibenzofuran
POTW	publicly owned treatment works
PPE	personal protective equipment
PRG	preliminary remediation goal
RAO	removal action objective
RAP	Remedial Action Plan
RAWP	Removal Action Work Plan
RBC	risk-based concentration
RCRA	Resource Conservation and Recovery Act
RG	removal goal
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RWQCB	Regional Water Quality Control Board
S/S	solidification/stabilization
SARA	Superfund Amendments and Reauthorization Act
SEV	screening-level ecological toxicity value
SI	Site Investigation
STLC	soluble threshold limit concentration
SVOC	semivolatile organic compound
SWDIV	Southwest Division Naval Facilities Engineering Command
TCDD	tetrachlorodibenzo-*p*-dioxin
TCDF	tetrachlorodibenzofuran
TCE	trichloroethylene
TCLP	Toxicity Characteristic Leaching Procedure
TMB	trimethylbenzene
TTU	temporary treatment unit
U.S. EPA	United States Environmental Protection Agency
USC	United States Code
USFWS	United States Fish and Wildlife Service
VOC	volatile organic compound

1.0 INTRODUCTION

1.1 Purpose and Objectives

This Engineering Evaluation/Cost Analysis (EE/CA) identifies proposed removal action alternatives for remediating the contaminated soils at Site 1111, Marine Corps Base (MCB) Camp Pendleton. This document fulfills specific objectives relating to the scope of work under the U.S. Naval Facilities Engineering Command Southwest Division (NFEC-SW)/Networld Exchange Incorporated Contract No. 1323-001.

This EE/CA addresses the implementability, effectiveness, and cost for proposed soil removal actions at Site 1111 and addresses applicable regulatory requirements for the site. Although Site 1111 soil and groundwater are addressed in the Operable Unit (OU)-5 Remedial Investigation/Feasibility Study (RI/FS), the United States Department of the Navy (DON) has decided to expedite the soil cleanup actions at Site 1111. Therefore, Site 1111 soils will be subjected to a removal action that is addressed in this EE/CA. The removal action for soils at Site 1111 is intended to be a final action for soils only and will likely be documented as such in the Record of Decision (ROD) for OU-5 Sites 1A-1, 6A, 21, 1111, and 12 Area. In addition, a remedy for groundwater at Site 1111 also will be documented in the OU-5 ROD. Because Site 1111 has been thoroughly discussed in the draft OU-5 FS (Parsons, 2005), this EE/CA significantly draws on the information presented therein.

1.2 Statutory Framework

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) define removal actions to include:

> *"...the cleanup or removal of released hazardous substances from the environment, such actions as may necessarily be taken in the event of the threat of release of hazardous substances into the environment, such action as may be necessary to monitor, assess, and evaluate the release or threat of release of hazardous substances, the disposal of removal material, or the taking of such other actions as may be necessary to prevent, minimize or mitigate damage to the public health or welfare or to the environment, which may otherwise result from a release or threat of release."*

The United States Environmental Protection Agency's Office of Solid Waste and Emergency Response (U.S. EPA, 1993) has classified removal actions into three types based on the circumstance surrounding the release or threat of release: emergency, time critical, and non-time critical. Figure 1-1 shows the non-time critical removal action process for CERCLA sites.

This removal action is taken in accordance with CERCLA and the NCP under the delegated authority of the Office of the President of the United States by Executive Order No. 12580. This order provides the DON with authorization to conduct and finance removal actions. This removal action is non-time critical because a 6-month planning period was available from the time a removal action was determined to be necessary before the initiation of the removal action. The requirements for this EE/CA and its mandated public comment period provide opportunity for public input to the cleanup process. The 30-day public comment period occurred from January 30 to February 28, 2006; no public comments were received.

The DON is the lead agency for the removal action. As such, the DON has final approval authority, with state concurrence, over the recommended alternative and all public participation activities. The DON is working in cooperation with California Environmental Protection Agency (Cal-EPA) Department of

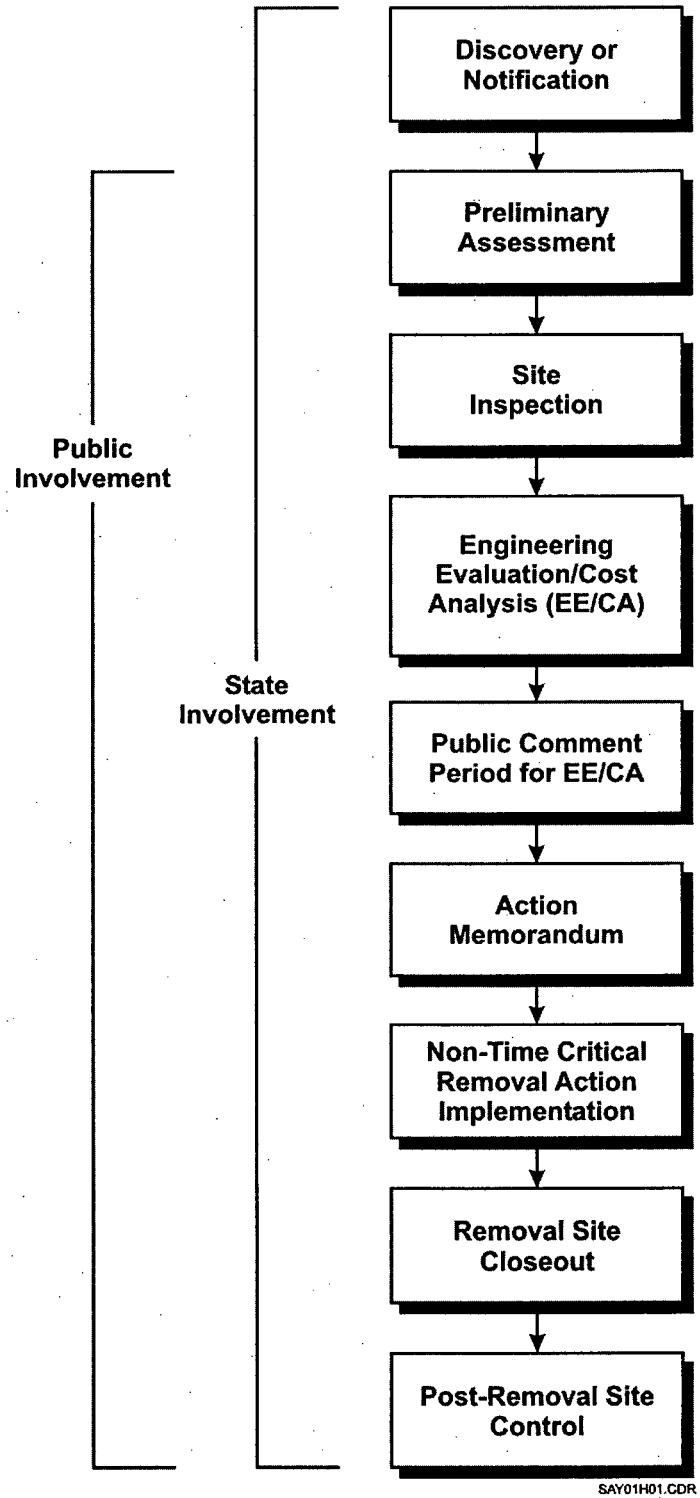


Figure 1-1. Non-Time Critical Removal Action Process

Toxic Substances Control (DTSC), Regional Water Quality Control Board (RWQCB), the U.S. EPA, and the public in the implementation of this removal action. This EE/CA complies with the requirements of CERCLA, Superfund Amendments and Reauthorization Act (SARA), NCP at 40 Code of Federal Regulations (CFR) Part 300, Defense Environmental Restoration Program (DERP) at 10 United States Code (USC) §2701, et seq., and Executive Order No. 12580. This EE/CA is being pursued under subsections (i) and (iv) of 40 CFR Part 300.415(b)(2):

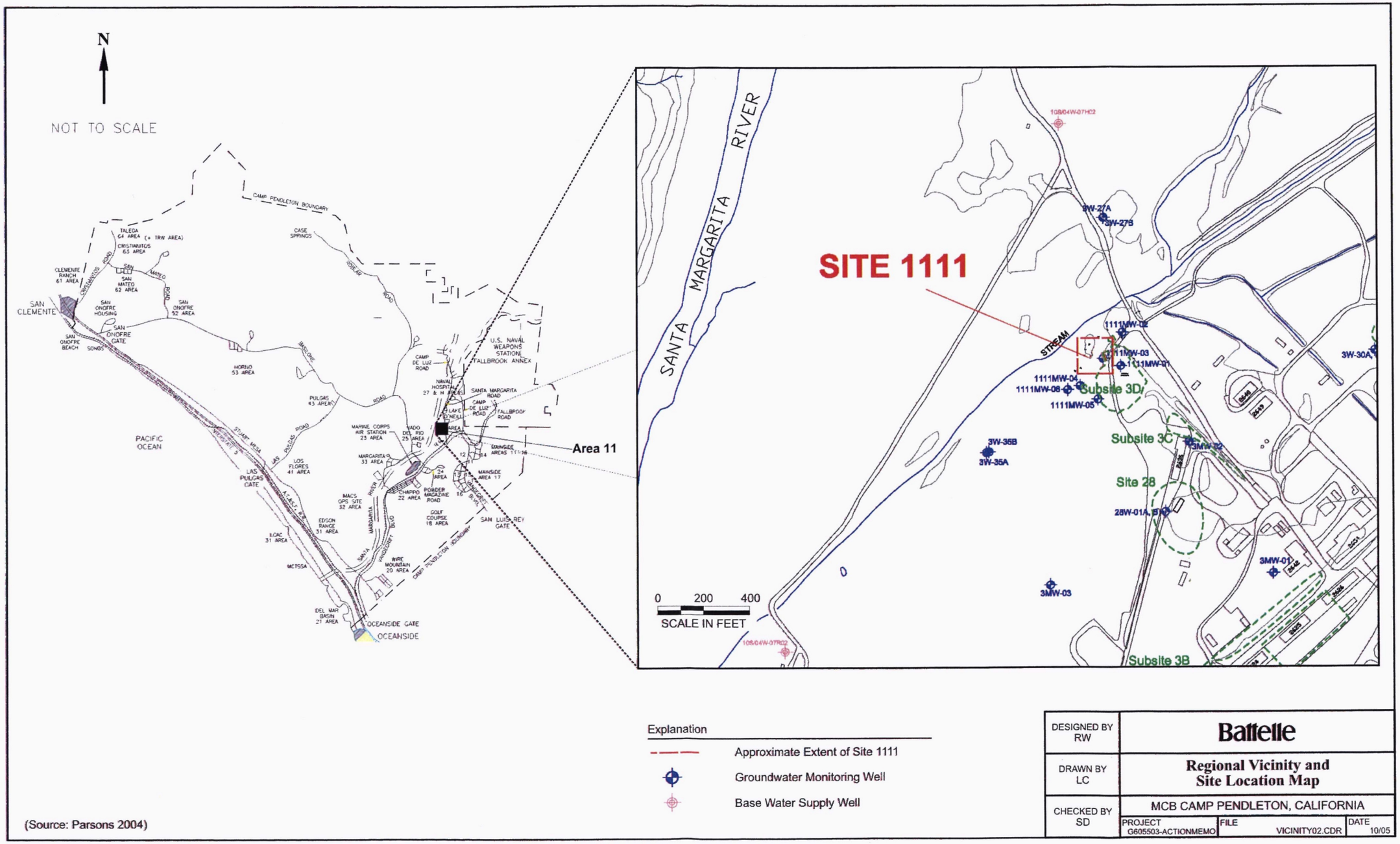
(i) Actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substance or pollutants or contaminants.

(iv) High levels of hazardous substances or pollutants or contaminants in soils largely at or near the surface that may leach to groundwater.

1.3 Site Location

MCB Camp Pendleton is located in northern San Diego County, CA, approximately halfway between the cities of Los Angeles and San Diego. Figure 1-2 shows the location of MCB Camp Pendleton, and Figure 1-3 shows the areal extent of Site 1111. Surrounding communities include San Clemente to the northwest, Oceanside to the south, and Fallbrook to the east. The base is bordered on the west by the Pacific Ocean and encompasses 17 miles of relatively undisturbed coastline. Rolling hills and valleys range inland an average of 10 to 12 miles. The base occupies approximately 125,000 acres of land and is the Marine Corps' primary amphibious training center.

Construction of MCB Camp Pendleton began in March 1942, and President Franklin D. Roosevelt dedicated the base in September 1942. It was designated as a permanent base in October 1944. Nearly 60,000 personnel train at Camp Pendleton every year, with more than 35,000 service members assigned to the base.



(Source: Parsons 2004)

Figure 1-2. Regional Vicinity and Site Location Map

Figure 1-3. Areal Extent of Site 1111

Site 1111 is located in the southeastern portion of the base adjacent to the former Site 3 Pesticide Wash Rack (see Figure 1-2). Site 1111 is not currently used for any military or civilian activity, and future land use will likely remain the same. The site also is located adjacent to an ecologically sensitive area.

1.4 Previous Work Performed at Site 1111

As previously noted, Site 1111 is located adjacent to the former Site 3 Pesticide Wash Rack, where equipment used to administer herbicides and pesticides were rinsed from the 1950s to the 1980s. In 1980, herbicides were discovered in production wells located within 0.5 mile and downgradient of former Site 3 (SWDIV, 1991). Metals, fuel hydrocarbons, and pesticides were detected in soil samples during the Site 3 Site Investigation (SI) (CDM, 1988). Site 3 was evaluated as part of the Group A Sites RI, which concluded that soils at Site 1111 posed an unacceptable threat to potential human and ecological receptors (SWDIV, 1993).

From May 1996 to January 1997, environmental activities at former Site 3 included the excavation, solidification, and stabilization of waste fill, and disposal of the fill into a Corrective Action Management Unit (CAMU) located on the base. During these remedial activities at Site 3, a subsurface layer of ash and burn material was exposed. This area, located in the northeast portion of Site 3, was excavated to the groundwater table, 5 to 6 ft below ground surface (bgs). Excavation was halted upon encountering an ecologically sensitive habitat. However, the contaminant levels in the undisturbed soil exceeded project removal goals. This undisturbed area was later designated as Site 1111 (Parsons, 2005).

Soil and groundwater sampling activities were initiated at Site 1111 as part of the OU-4 RI report in May and December 1998. The May 1998 sampling event focused on delineation of the burn area and a groundwater quality evaluation for areas underneath the burn area (Parsons, 1999). Because further data were required to delineate the extent of contamination, Site 1111 was transferred from OU-4 to OU-5 in order to collect additional data. Additional sampling was conducted as part of the OU-5 field investigation in 2001 and 2002, and in 2003 as part of a supplemental field investigation for OU-5 sites (Parsons, 2005).

1.5 Report Organization

This report is organized into the following sections: Section 2.0 describes the site characteristics and current site conditions; Section 3.0 identifies removal action objectives (RAOs) and removal goals (RGs); Section 4.0 presents the identification and analysis of removal action alternatives by addressing the effectiveness, implementability, and cost of removal actions for contaminated soils and groundwater at

Site 1111; Section 5.0 presents a comparative analysis of these removal action alternatives; and, Section 6.0 recommends the preferred removal action alternative.

Two appendices support the text. Appendix A provides a detailed matrix of applicable or relevant and appropriate requirements (ARARs) for this removal action, and Appendix B provides cost information for selected technologies evaluated for the removal action.

2.0 SITE CHARACTERIZATION

The information presented in this section was taken from previous environmental investigations, including the following:

- *RI/FS Report for Group A Sites, Draft Final (Site 3)* (SWDIV, 1993)
- *Draft Final Remedial Investigation Report for OU-5 Sites 1A-1, 6A, 21, 1111, and 12 Area (Site 13)* (Parsons, 2004)
- *Draft Feasibility Study for OU-5 Sites 1A-1, 6A, 21, 1111, and 12 Area (Site 13)* (Parsons, 2005).

2.1 Site Description

The site description and background information presented herein summarizes information collected during previous site investigations conducted at Site 1111. No new data were collected in the preparation of this EE/CA.

2.1.1 Land Use

Figure 2-1 contains a map of Site 1111. The site currently is not used for any military or civilian activity. Land use to the east and southeast consists of vehicle maintenance and material storage. The Marine Corps Air Station (MCAS) and associated operations are located southeast of the site. The nearest designated troop housing areas are Vado Del Rio (25 Area) and 24 Area, and are located approximately 1 mile north of Site 1111. The nearest family housing is at the Ranch House, located about 1 mile southeast of the site and in the De Luz Area, approximately 1.5 miles northeast of the site. Future land use plans indicate that use of this site will likely remain the same. The likelihood of future residential use is considered low given current development plans, current land use in the vicinity of the site, the presence of sensitive ecological habitat, and the location of the site within the flood plain of the Santa Margarita River.

The nearest downgradient in-service base production well, 10S/4W-7R2, is located 1,850 ft southeast of the site (Figure 2-1). An upgradient groundwater production well, 10S/4W-7H2, is located 1,300 ft north of the site. Both wells are in service. Additionally, the DON is planning to install a new production well in the vicinity of Site 1111 during third quarter 2006 to alleviate shortages of drinking water at the base.

2.1.2 Ecology

The proximity of Site 1111 to the Santa Margarita River is ecologically significant because the area supports a diverse array of wildlife and plant species. Approximately 10 to 20 mammal species and 80 resident and migratory bird species likely use the site and its vicinity. About 8 to 10 species of amphibians and reptiles probably occur in the site vicinity, including Western Toad and Common King Snake. The adjacent riparian habitats of the Santa Margarita River support numerous endangered and threatened wildlife species, including the Arroyo Southwestern Toad, Pacific Pocket Mouse, Southwestern Pond Turtle, Least Bell's Vireo, and Southwestern Willow Flycatcher. The undisturbed portion of Site 1111 is considered Arroyo Southwestern Toad habitat, and therefore is a sensitive ecological habitat. Least Bell's Vireos and Southwestern Willow Flycatchers also are known to nest at Site 1111 (Parsons, 2005). Vegetation has been removed in the disturbed portion (due to previous removal activities) of Site 1111.

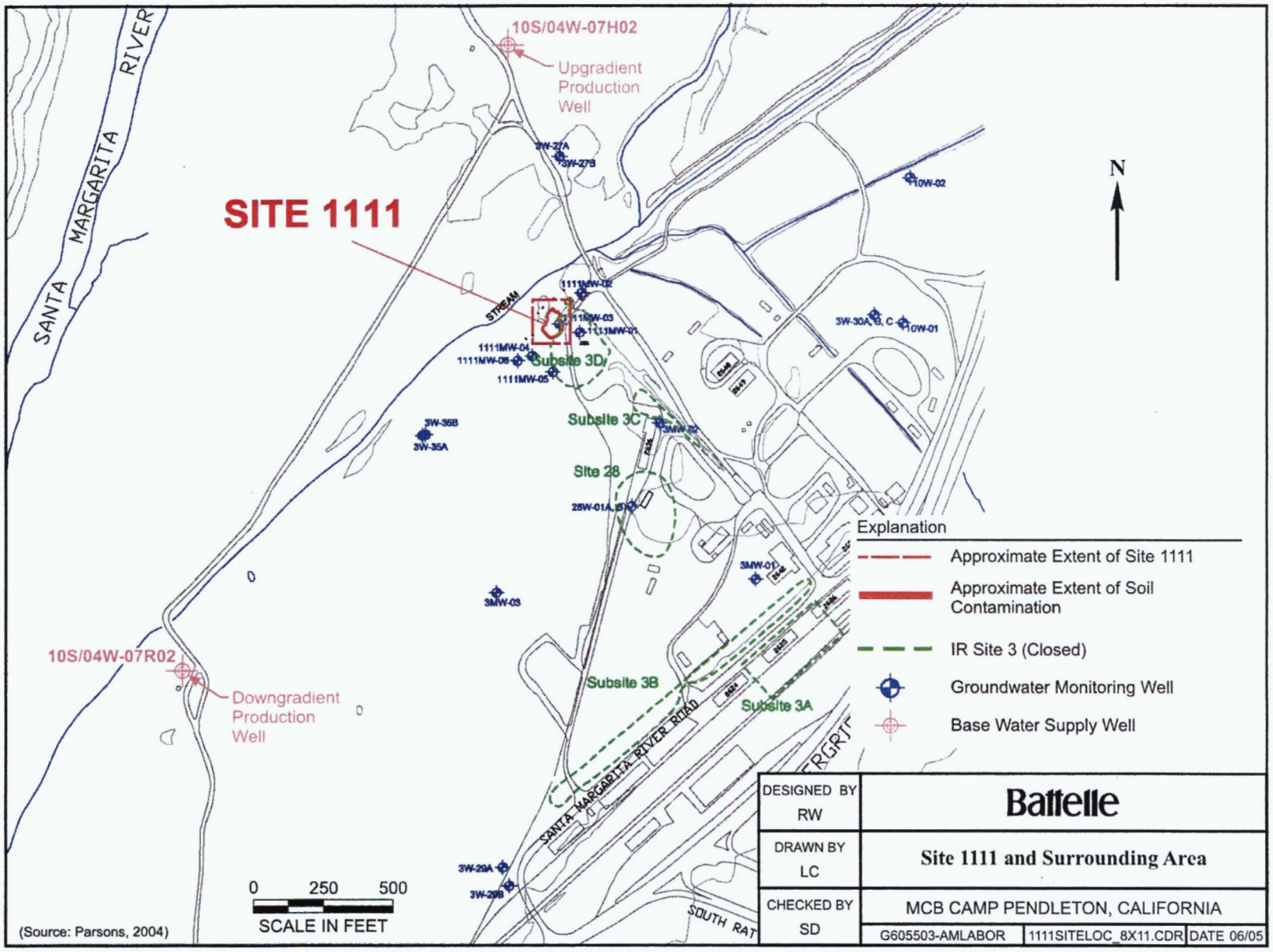


Figure 2-1. Site 1111 and Surrounding Area

2.1.3 Topography

The southern portion of the site is relatively level, compared to the northern portion of the site, which has several small hills, berms, and drainage channels. Total vertical relief at the site is 105 to 95 ft above mean sea level (amsl). The topography at Site 1111 generally slopes gently toward the southwest parallel to the Santa Margarita River channel, although locally three knolls of very coarse (cobbles and boulders) alluvial deposits are elevated above the general site topography. In addition, a channel-like feature meanders around the perimeter of the knolls, and this area is intermittently inundated with water. The knolls impart a hummocky topographic expression to the area. The knolls generally rise 5 to 10 ft above the general topography (Parsons, 2005). Figure 2-1 shows topographic features of Site 1111.

2.1.4 Surface Water

Site 1111 is located immediately east of, and adjacent to, a southwest-flowing drainage within the Santa Margarita River Basin, approximately 2,300 ft east of the center of the Santa Margarita River. Surface water is intermittently present on or near the site, particularly during or after rainy weather. A drainage swale exists in the northern portion of the site that collects and diverts surface water runoff toward the northwest. Also, surface water collects in a low-lying area southwest of the site. Surface water, when present, generally flows toward the west, to the southwest-flowing stream (Parsons, 2005). Figure 2-1 shows the proximity of Site 1111 to the nearby surface water body.

2.1.5 Geology

Site 1111 is located within the Peninsular Range Geomorphic Province of southern California. Based on available geologic references, as well as field observations, deposits underlying the site and surrounding vicinity are largely limited to unconsolidated deposits of younger alluvium (Moyle, 1975; as noted in Parsons, 2005), which consist of boulders, gravel, sand, and silt. At Site 1111, these alluvial deposits are associated with the Santa Margarita River. Bedrock formations are inferred to underlie younger alluvium at depth, and likely include the La Jolla Group rocks (i.e., rocks of the Santiago Formation) and the basement complex rocks (i.e., igneous and metamorphic rocks).

The uppermost member of rocks previously mapped as the La Jolla Group has been assigned to the Eocene Santiago Formation (Cranham et al., 1994; Parsons 2005). The Santiago Formation broadly consists of inter-bedded sandstone, siltstone, and mudstone, and underlies the hills located just east of Site 1111. Neither the Santiago Formation nor the underlying basement complex is exposed at the surface at Site 1111. Younger pre-Tertiary Formations are presumably absent beneath the Younger Alluvium in the Site 1111. These younger absent formations include: the Late Eocene to early Miocene San Onofre Breccia Formation; the Late Miocene Monterey Formation; the Late Miocene/early Pliocene Capistrano Formation; and Late Pliocene/Early Pleistocene San Mateo Formation.

Based on borings drilled to a maximum depth of 20 ft, shallow subsurface soils consist of primarily of poorly graded (i.e., moderately well sorted) sand with trace amount of silt, which are interbedded in some areas with silty sand. Also, based on results of previous and current subsurface investigations, soil beneath Site 1111 consists of the following:

- Gravel backfill (from previous removal activity), at ground surface to approximately 5 ft bgs;
- Disturbed material/soil consisting of burnt wood, discolored soil, lenses of blue and white clay-like material, and debris, at approximately 2.5 to 10 ft bgs; and,
- Sand and silty sand, at ground surface to 20 ft bgs (maximum depth investigated).

Based on the observations recorded in boring logs, soils are generally moist with saturated samples collected below a depth of 5-11 ft bgs (Parsons, 2005). The locations of geologic cross sections for Site 1111 are shown on Figure 2-2, and associated cross sections are presented in Figures 2-3 and 2-4.

2.1.6 Hydrogeology

As documented in previous investigations, groundwater was encountered in an unconfined shallow zone at depths of 5-11 ft bgs. There was no indication of a deeper groundwater zone, although a deeper zone separated by fine-grained material may exist at depth between 50 and 100 ft bgs.

2.1.6.1 Saturated Thickness

The saturated thickness of the shallow water-bearing deposits has been approximated based on the following: (1) the screened interval of the shallow or deep wells; (2) descriptions of permeable sediments found in the boring logs; and (3) the height of the water column in the shallow wells. As shown in cross sections for Site 1111 (see Figures 2-3 and 2-4), all of the shallow wells are interpreted to be screened across shallow alluvial soils. Based on March 2003 water levels, the height of the water column in the shallow wells ranges from about 9.5 to 13 ft, and during December 1998, the water column height ranged from about 9 to 12 ft (Parsons, 2005).

2.1.6.2 Water Levels

In March 2003, which was the most recent site-wide groundwater sampling event, water levels in wells 1111MW-01, -02, -04, -05, and -06 were recorded. During this monitoring event, depth to water in these five shallow wells ranged from 5.9 to 10.5 ft bgs (Parsons, 2005).

2.1.6.3 Groundwater Flow Direction and Gradient

Groundwater elevation contours in Site 1111 are depicted in Figure 2-2 based on water-level data from the shallow wells measured during the March 2003 sampling event. As indicated, groundwater flow is generally toward the southwest at an average gradient of approximately 0.002 ft/ft. Observed groundwater elevations relative to geologic units are shown on cross section A-A′ (Figure 2-3), which is oriented approximately to the direction of groundwater flow.

2.2 Nature and Extent of Contamination

As discussed in the OU-5 RI (Parsons, 2004) and OU-5 FS (Parsons, 2005), a soil removal action was performed adjacent to Site 1111 (at former Site 3) in 1997. Based on site history, contaminants of potential concern (COPCs) at Site 1111 include metals and various organic compounds such as pesticides, chlorinated herbicides, fuels, solvents, and byproducts associated with the combustion of these materials (e.g., polycyclic aromatic hydrocarbons [PAHs] and dioxins/furans). The highest concentrations of soil constituents at Site 1111 were detected within the burn layer. Soil constituents detected at the site are presented in Table 2-1.

The volume of soil exceeding RGs at Site 1111 is approximately 1,100 yd^3; development of RGs is discussed Section 3.0. This volume represents a 0.12-acre lateral extent of impacted soils extending to a depth of 6 ft bgs. Figure 2-2 shows the location of the former burn area and the areal extent of contamination.

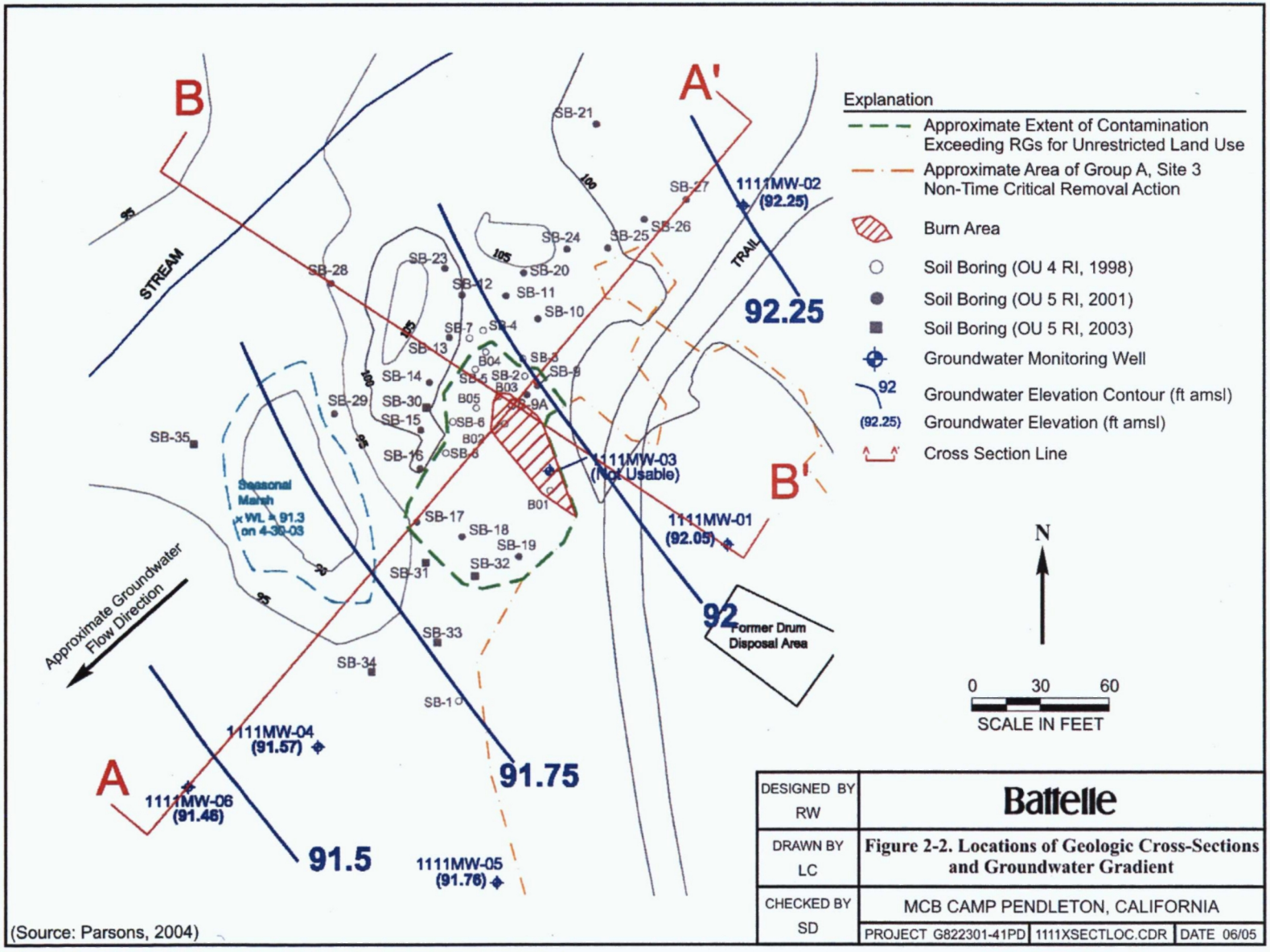


Figure 2-2. Location of Geologic Cross Sections and Groundwater Gradient at Site 1111

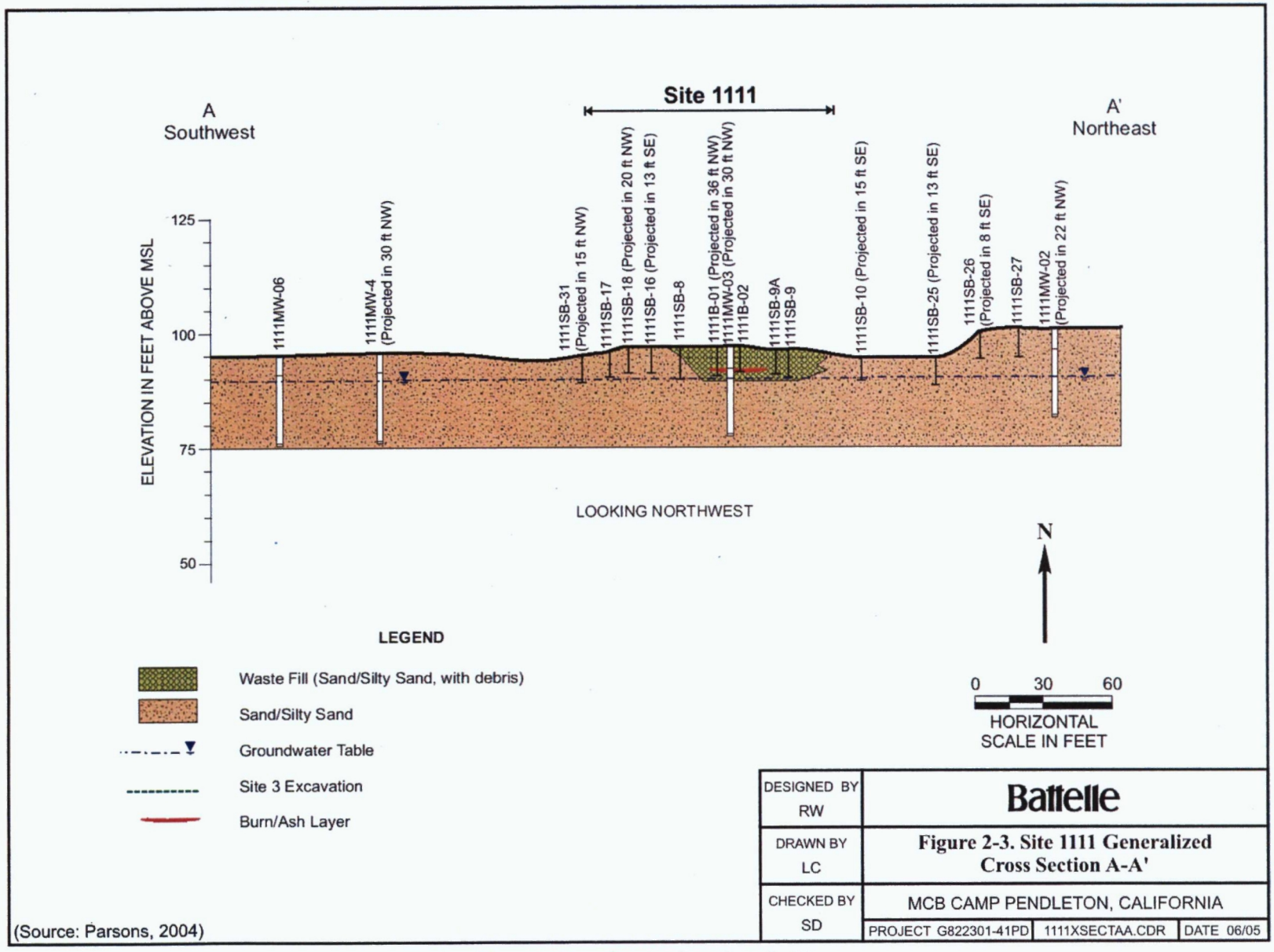


Figure 2-3. Cross Section A-A'

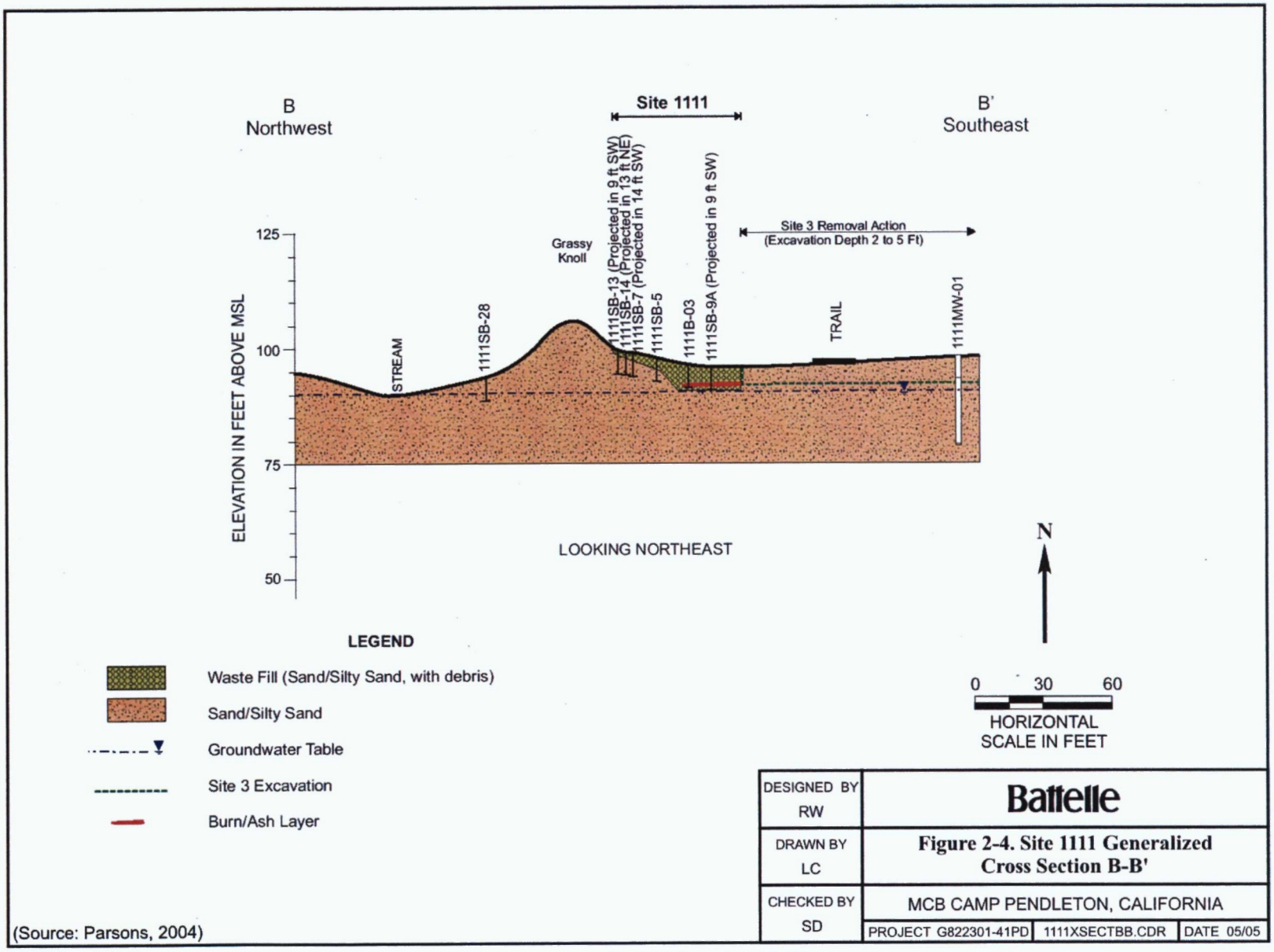


Figure 2-4. Cross Section B-B'

Table 2-1. Maximum Detected Concentrations of Soil Constituents at Site 1111 During OU-4 (1998) and OU-5 (2004) Remedial Investigations

Constituent	Number of Samples OU5 RI (OU4 RI)	Number of Detections OU5 RI (OU4 RI)	Maximum Detected Concentration OU5 RI (OU4 RI)
Volatile Organic Compounds (µg/kg)			
1,1-Dichloroethene	NA (47)	NA (1)	NA (17)
1,2,3-Trichlorobenzene	NA (47)	NA (1)	NA (11)
1,2,4-Trimethylbenzene	51(NA)	4 (NA)	220000 (NA)
1,2-Dichlorobenzene	NA (54)	NA (1)	NA (7)
1,3,5-Trimethylbenzene	51(47)	4 (1)	70800 (4.3)
1,3-Dichlorobenzene	NA (54)	NA (1)	NA (10)
4-Methyl-2-pentanone	51(NA)	2 (NA)	1100 (NA)
Acetone	NA (47)	NA (3)	NA (52)
Benzene	NA (47)	NA (2)	NA (5.2)
Carbon Disulfide	NA (47)	NA (1)	NA (6.4)
Chloroform	NA (47)	NA (5)	NA (400)
cis-1,2-DCE	NA (47)	NA (9)	NA (840)
Ethylbenzene	51(47)	3 (1)	11000 (1.7)
Isopropylbenzene	51(NA)	3 (NA)	17000 (NA)
m,p-Xylene	51(NA)	3 (NA)	46400 (NA)
Methylene Chloride	51(47)	8 (2)	1200 (10)
MTBE	51(NA)	1 (NA)	ND (NA)
Naphthalene	51(NA)	3 (NA)	40600 (NA)
n-Propylbenzene	51(NA)	3 (NA)	32700 (NA)
o-Xylene	51(NA)	3 (NA)	29000 (NA)
p-Isopropyltoluene	51(47)	4 (1)	34500 (2)
sec-Butylbenzene	51(47)	3 (1)	25000 (2)
PCE	51(47)	0 (6)	ND (980)
Toluene	51(47)	3 (2)	4400 (3.5)
trans-1,2-DCE	NA (47)	NA (5)	NA (510)
TCE	51(47)	4 (10)	ND (11500)
Vinyl chloride	NA (47)	NA (1)	NA (4.1)
Semivolatile Organic Compounds (µg/kg)			
2,4-Dimethylphenol	NA (50)	NA (2)	NA (100)
2,4-Dinitrophenol	NA (50)	NA (1)	NA (1000)
2-Methylnaphthalene	76 (50)	1 (2)	ND (240)
3,4-Methylphenol	NA (10)	NA (2)	NA (300)
Acenaphthene	NA (50)	NA (2)	NA (140)
Anthracene	NA (50)	NA (2)	NA (390)
Benzo(a)anthracene	76 (50)	1 (4)	ND (260)
Benzo(a)pyrene	76 (50)	1 (2)	ND (200)
Benzo(b)fluoranthene	NA (50)	NA (4)	NA (200)
Benzo(g,h,i)perylene	NA (50)	NA (3)	NA (300)
Benzo(k)fluoranthene	NA (50)	NA (1)	NA (36)
Benzoic acid	NA (50)	NA (2)	NA (5000)
bis(2-Ethylhexyl)phthalate	76 (50)	1 (17)	ND (1200)
Chrysene	76 (50)	1 (2)	ND (500)
Dimethylphthalate	NA (50)	NA (1)	NA (200)
di-*n*-Butylphthalate	NA (50)	NA (1)	NA (48)

Table 2-1. Maximum Detected Concentrations of Soil Constituents at Site 1111 During OU-4 (1998) and OU-5 (2004) Remedial Investigations (Continued)

Constituent	Number of Samples OU5 RI (OU4 RI)	Number of Detections OU5 RI (OU4 RI)	Maximum Detected Concentration OU5 RI (OU4 RI)
Fluoranthene	76 (50)	2 (5)	ND (400)
Fluorene	NA (50)	NA (1)	NA (710)
Hexachlorobenzene	NA (50)	NA (1)	NA (1800)
Naphthalene	76 (50)	2 (2)	1370 (200)
Phenanthrene	76 (50)	2 (4)	ND (1800)
Pyrene	76 (50)	1 (5)	ND (400)
Pesticides (µg/kg)			
4,4'-DDD	77 (50)	64 (47)	3000 (44500)
4,4'-DDE	77 (50)	67 (48)	4800 (43000)
4,4'-DDT	77 (50)	66 (47)	13000 (17000)
Aldrin	NA (50)	NA (1)	NA (3)
Alpha chlordane	68 (NA)	1 (NA)	2.5 (NA)
Dieldrin	NA (50)	NA (3)	NA (3)
Endosulfan I	NA (50)	NA (1)	NA (25)
Endosulfan II	NA (50)	NA (1)	NA (5)
Endosulfan sulfate	NA (50)	NA (1)	NA (2)
Endrin aldehyde	NA (50)	NA (2)	NA (75)
Endrin ketone	NA (10)	NA (1)	NA (8)
Heptachlor epoxide	NA (50)	NA (2)	NA (9)
Methoxychlor	NA (50)	NA (3)	NA (15)
Herbicides (µg/kg)			
Dinoseb	60 (NA)	7 (NA)	2 (NA)
Pentachlorophenol	60 (NA)	8 (NA)	56
Metals (mg/kg)			
Aluminum	77 (50)	77 (50)	12800 (15200)
Antimony	77 (50)	12 (17)	ND (3210)
Arsenic	77 (50)	10 (12)	7.4 (71.5)
Barium	77 (50)	77 (50)	160 (2470)
Beryllium	77 (50)	0 (11)	ND (0.38)
Cadmium	77 (50)	9 (12)	ND (8.87)
Calcium	77 (50)	77 (50)	6780 (15500)
Chromium (hexavalent)	75 (50)	2 (4)	0.35 (28.4)
Chromium (total)	77 (50)	60 (50)	58.8 (931)
Cobalt	77 (50)	77 (47)	229 (28.1)
Copper	77 (50)	46 (36)	416 (34100)
Iron	77 (50)	77 (50)	51700 (299000)
Lead	77 (50)	52 (30)	1470 (19300)
Magnesium	77 (50)	77 (50)	5100 (5870)
Manganese	77 (50)	77 (50)	1760 (2770)
Mercury	75 (50)	73 (13)	3.7 (3650)
Molybdenum	77 (50)	0 (12)	ND (31.7)
Nickel	77 (52)	65 (38)	32.1 (132)
Potassium	77 (50)	77 (49)	4530 (5010)
Selenium	77 (50)	5 (3)	ND (0.5)
Silver	77 (50)	0 (11)	ND (1.45)
Sodium	77 (50)	0 (13)	ND (5490)

Table 2-1. Maximum Detected Concentrations of Soil Constituents at Site 1111 During OU-4 (1998) and OU-5 (2004) Remedial Investigations (Continued)

Constituent	Number of Samples OU5 RI (OU4 RI)	Number of Detections OU5 RI (OU4 RI)	Maximum Detected Concentration OU5 RI (OU4 RI)
Thallium	77 (50)	0 (10)	ND (6)
Vanadium	77 (50)	77 (50)	49.8 (48.7)
Zinc	77 (50)	77 (50)	289 (22800)
Dioxins/Furans (pg/g)			
1,2,3,4,6,7,8,9-OCDD	6 (NA)	4 (NA)	720 (NA)
1,2,3,4,6,7,8,9-OCDF	6 (NA)	4 (NA)	160 (NA)
1,2,3,4,6,7,8-HpCDD	6 (12)	3 (10)	450 (24110)
1,2,3,4,6,7,8-HpCDF	6 (12)	3 (10)	520 (3930)
1,2,3,4,7,8,9-HpCDF	6 (12)	0 (8)	ND (386)
1,2,3,4,7,8-HxCDD	6 (12)	0 (8)	ND (535)
1,2,3,4,7,8-HxCDF	6 (12)	3 (10)	270 (1310)
1,2,3,6,7,8-HxCDD	6 (12)	1 (9)	80 (1520)
1,2,3,6,7,8-HxCDF	6 (12)	1 (10)	90 (452)
1,2,3,7,8,9-HxCDD	6 (12)	1 (9)	110 (2130)
1,2,3,7,8,9-HxCDF	6 (12)	0 (8)	ND (95)
1,2,3,7,8-PeCDD	6 (12)	0 (9)	ND (383)
1,2,3,7,8-PeCDF	6 (12)	0 (9)	ND (232)
2,3,4,6,7,8-HxCDF	6 (12)	3 (9)	160 (520)
2,3,4,7,8-PeCDF	6 (12)	1 (9)	90 (400)
2,3,7,8-TCDD	6 (12)	0 (8)	ND (70.8)
2,3,7,8-TCDF	6 (12)	2 (9)	170 (103)
OCDD	NA (12)	NA (11)	NA (40710)
OCDF	NA (12)	NA (9)	NA (5280)
TCDD	NA (12)	NA (9)	NA (1710)
Total HpCDD	NA (12)	NA (10)	NA (40990)
Total HpCDF	NA (12)	NA (10)	NA (7880)
Total HxCDD	NA (12)	NA (10)	NA (16340)
Total HxCDF	NA (12)	NA (10)	NA (5710)
Total PeCDD	NA (12)	NA (9)	NA (4530)
Total PeCDF	NA (12)	NA (9)	NA (7400)
Total TCDF	NA (12)	NA (9)	NA (5400)
2,3,7,8-TCDD Toxicity Equivalents	6 (12)	4 (11)	230.38 (42308)

Source: Parsons (2005).
NA = not analyzed for in RI.
ND = not detected.

HpCDD = heptachlorodibenzo-*p*-dioxin.
HpCDF = heptachlorodibenzofuran.
HxCDD = hexachlorodibenzo-*p*-dioxin.
HxCDF = hexachlorodibenzofuran.
OCDD = octachlorodibenzo-*p*-dioxin.
OCDF = octachlorodibenzofuran.
PeCDD = pentachlorodibenzo-*p*-dioxin.
PeCDF = pentachlorodibenzofuran.
TCDD = tetrachlorodibenzo-*p*-dioxin.
TCDF = tetrachlorodibenzofuran.

Locations of volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides and herbicides, 2,3,7,8-dioxin toxicity equivalents, and metals detected in soil samples during the OU-5 RI (Parsons, 2004) are summarized in Figures 2-5, 2-6, 2-7, 2-8, and 2-9, respectively. High VOC concentrations were detected at 2.5 to 4.0 ft and 4.5 to 6.0 ft from 1111SB-09, which was located in the east-central portion of the study area. VOCs detected in these two samples included 1,2,4-trimethylbenzene (TMB), 1,3,5-TMB, ethylbenzene, toluene, xylenes, methyl-*tert*-butyl ether (MTBE), propylbenzenes, *p*-isopropyltoluene, *sec*-butylbenzene, 4-methyl-2-pentanone, naphthalene, and methylene chloride. High concentrations of trichloroethylene (TCE) and tetrachloroethylene (PCE) were detected from 1111MW-03 (see Figure 2-5). Most of the detected SVOCs were identified from 0-5.5 ft bgs from 1111MW-03 (see Figure 2-6); maximum concentrations seen for 2-methyl-naphthalene, acenaphthene, anthracene, benzo(a)anthracene, fluorene, hexachlorobenzene, naphthalene, phenanthrene, and pyrene were detected in this sample.

Soils samples collected from the site contained a measurable quantity of pesticides; however, most were present at low concentrations. The highest concentrations of DDD, DDE, and DDT were detected from 1111SB-02, 1111MW-03, and 1111B02, respectively (see Figure 2-7). Dioxins/furans were predominantly detected in the samples collected from the burn area; the highest concentrations were detected at from 1111MW-03 (see Figure 2-8). Arsenic, mercury, and lead also were detected at high concentrations around the burn area; concentrations of metals in borings outside the burn layer were generally consistent with background levels (see Figure 2-9). Detailed discussions pertaining to the nature and extent of contamination can be found in the OU-5 RI (Parsons, 2004).

2.3 Contaminants of Concern

This section summarizes contaminants of concern (COCs) at Site 1111 based on the results of the human health risk assessment (HHRA), the ecological risk assessment (ERA), and the assessment of risk to groundwater posed by vadose zone soils that were conducted as part of the OU-5 RI (Parsons, 2004) and the OU-5 FS (Parsons, 2005). In addition, because the HHRA performed as part of the OU-5 RI and FS only identified COCs for a restricted land-use scenario, COCs also were screened and identified for an unrestricted (i.e., residential) land-use scenario in this EE/CA by comparing the maximum detected concentration of each constituent to an appropriate (i.e., residential) risk-based concentration (RBC). This was done so that the areal extent and the volume of soil exceeding RGs for an unrestricted land-use scenario can be identified and removed, thus allowing the site to be closed without the need for institutional controls or further monitoring.

2.3.1 Human Health Risk Assessment

Chemicals detected at least once in soils at Site 1111 were identified as preliminary COPCs for the HHRA performed during the OU-5 RI (Parsons, 2004) and OU-5 FS (Parsons, 2005). However, the following COPCs were eliminated and not carried through to the HHRA for an unrestricted land use scenario: (1) COPCs that were detected infrequently and at low concentrations (i.e., less than 5 percent frequency of detection and at concentrations slightly above the method detection limit [MDL]); and (2) inorganic COPCs that are considered essential human nutrients and are toxic only at very high doses (i.e., much higher than those associated with exposure at a site). Based on these criteria, 34 organic COPCs were eliminated from consideration in the HHRA because they were detected in less than 5 percent of the soil samples (for each interval) and the detected concentrations were within two times their respective maximum MDLs. In addition, calcium, iron, magnesium, potassium, and sodium were eliminated from the HHRA because either these chemicals were not considered toxic via soil exposure pathways, or the maximum detected concentrations were less than their respective essential nutrient soil screening levels. Although ethylbenzene, isopropylbenzene, methylene chloride, 4-methyl-2-pentanone, MTBE, naphthalene, *n*-propylbenzene, *p*-isopropyltoluene, *sec*-butylbenzene, 1,2,4-TMB, 1,3,5-TMB,

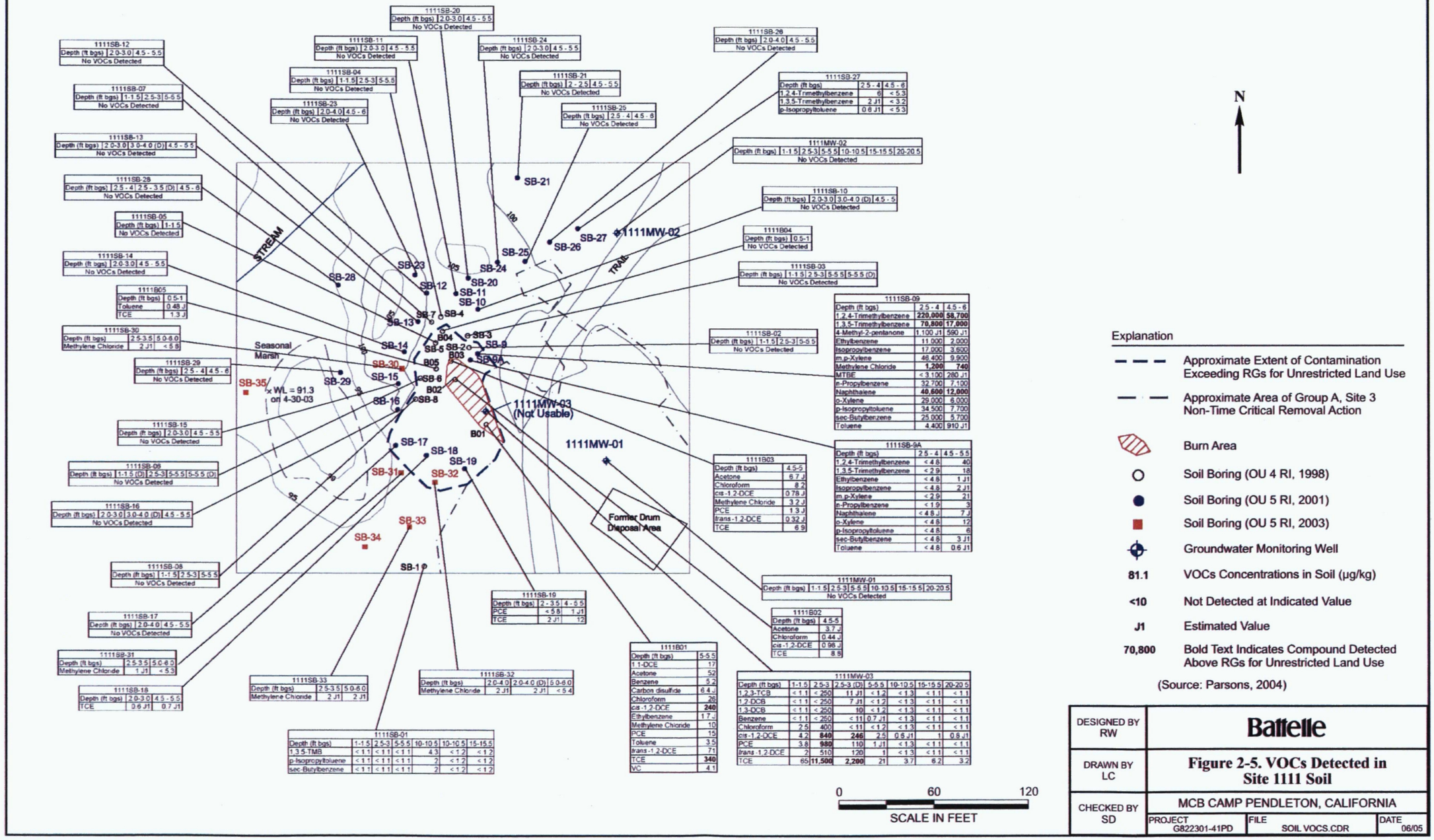


Figure 2-5. VOCs Detected in Site 1111 Soil

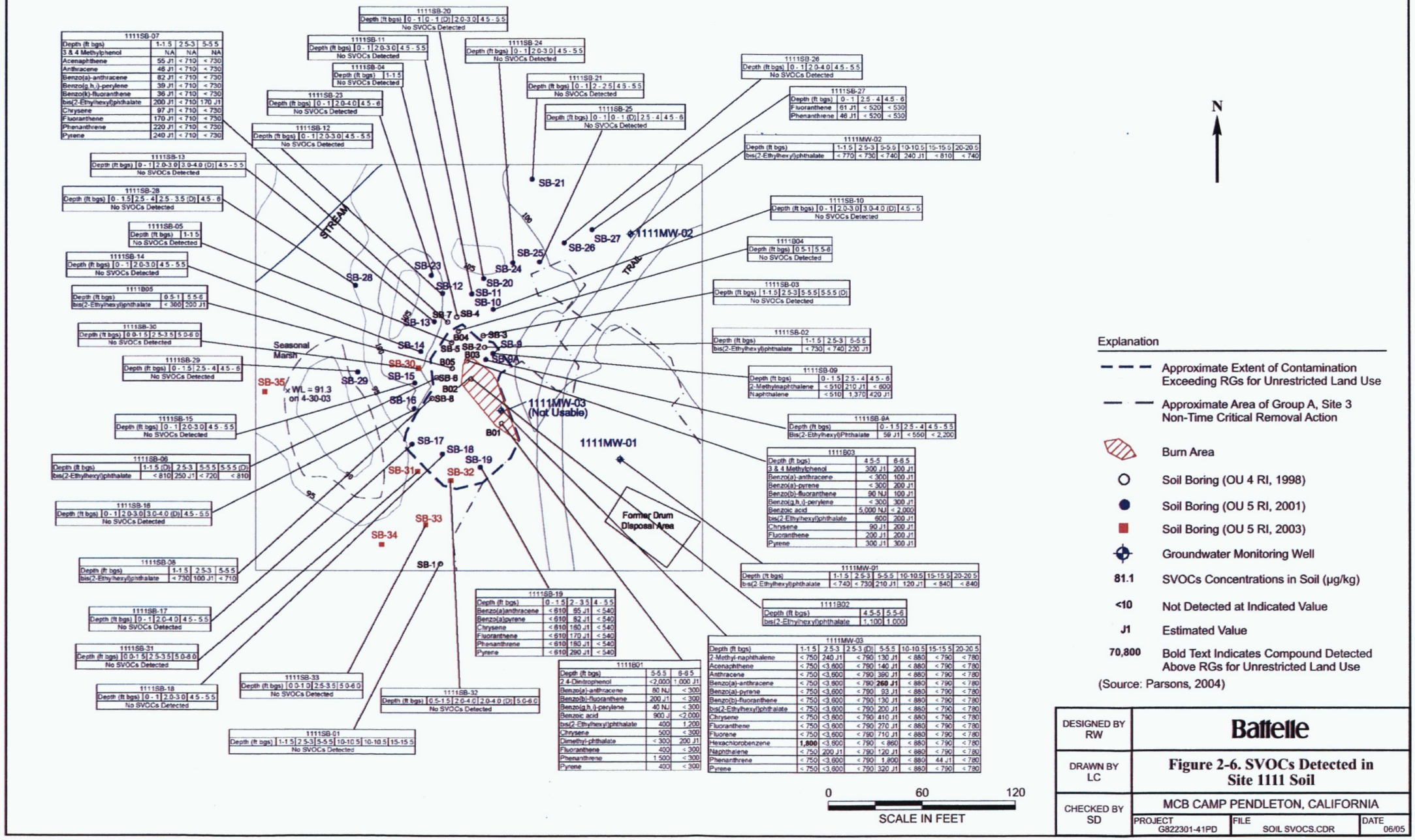


Figure 2-6. SVOCs Detected in Site 1111 Soil

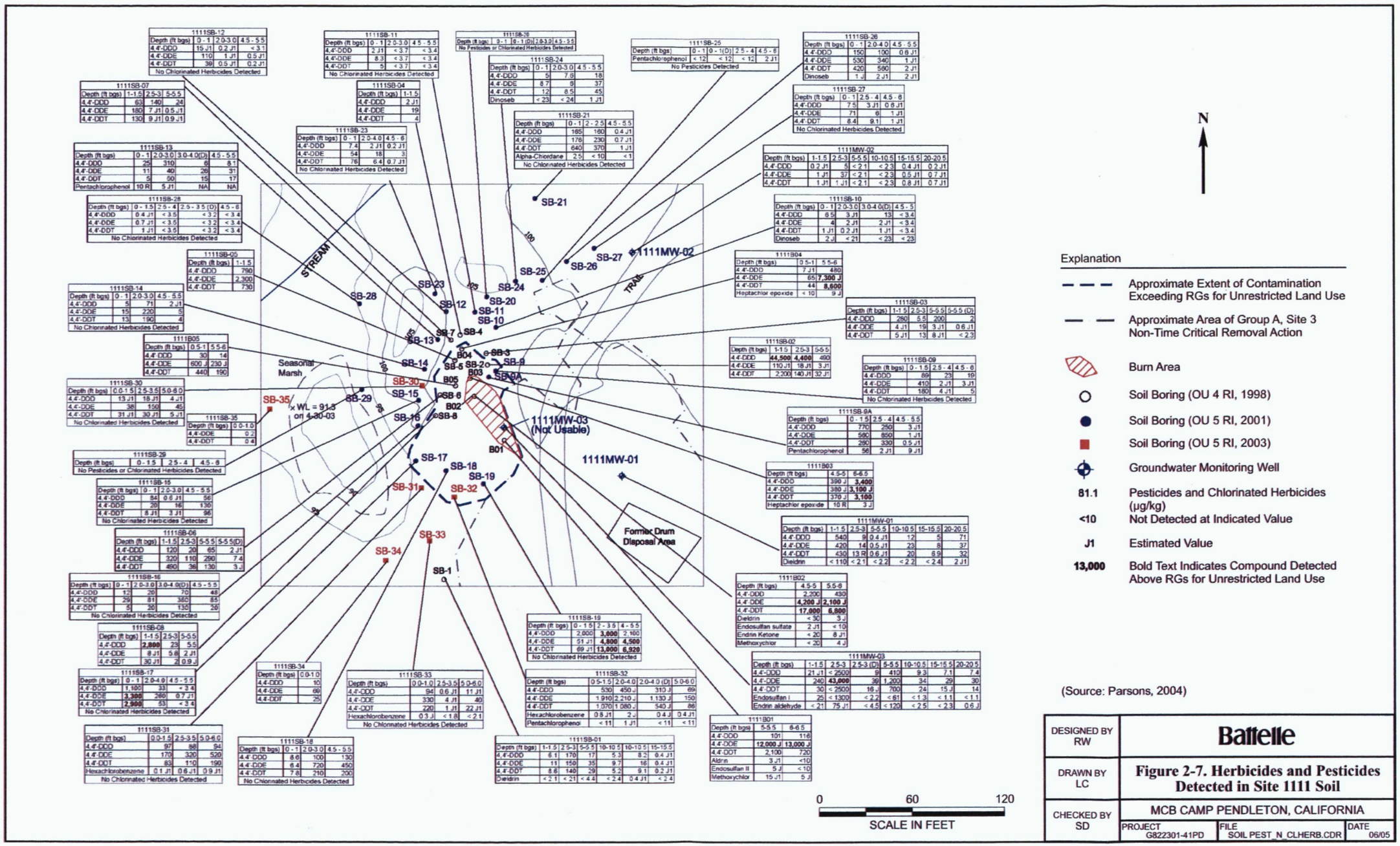


Figure 2-7. Herbicides and Pesticides Detected in Site 1111 Soil

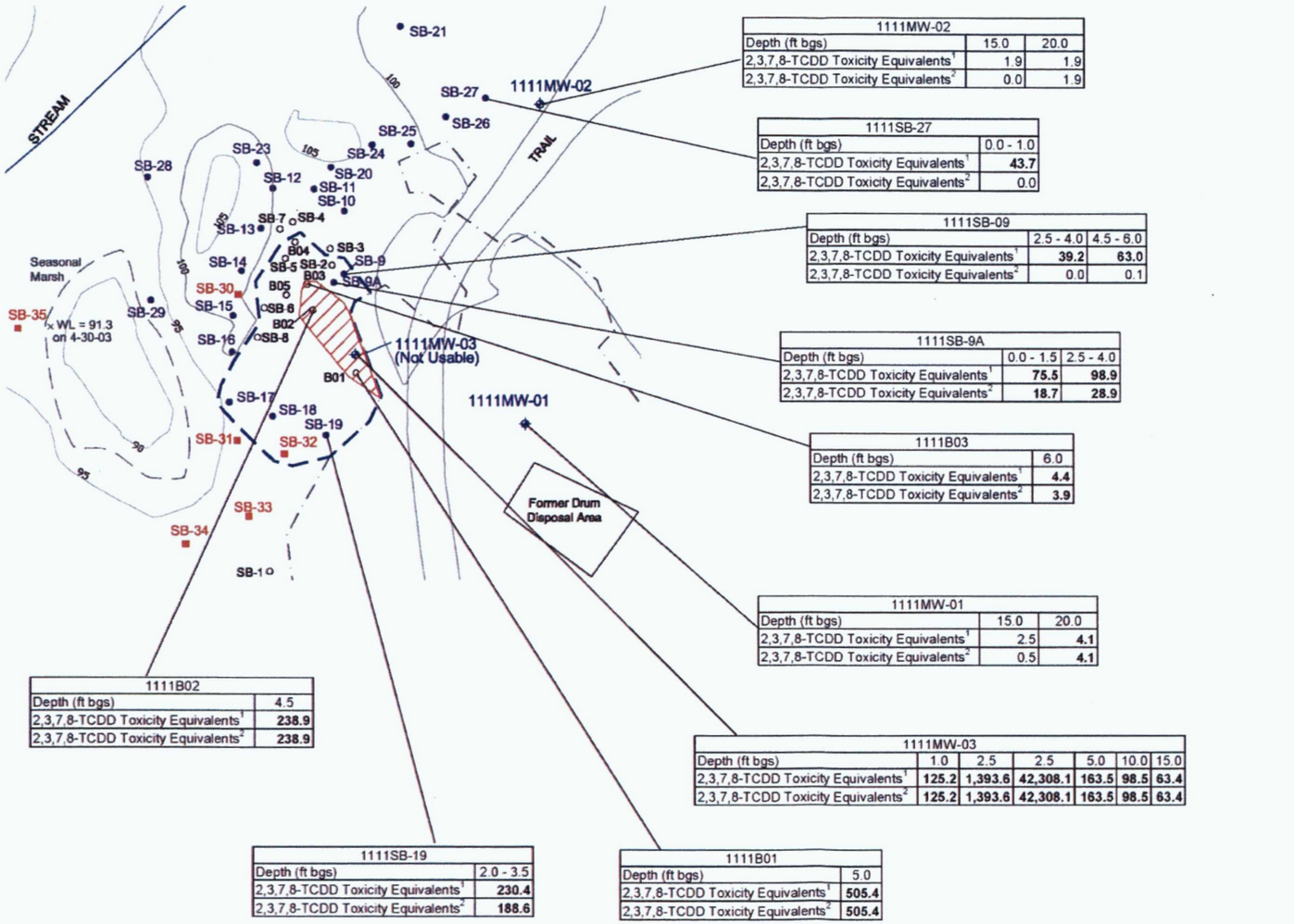


Figure 2-8. 2,3,7,8-TCDD Toxicity Equivalent Results for Site 1111 Soil

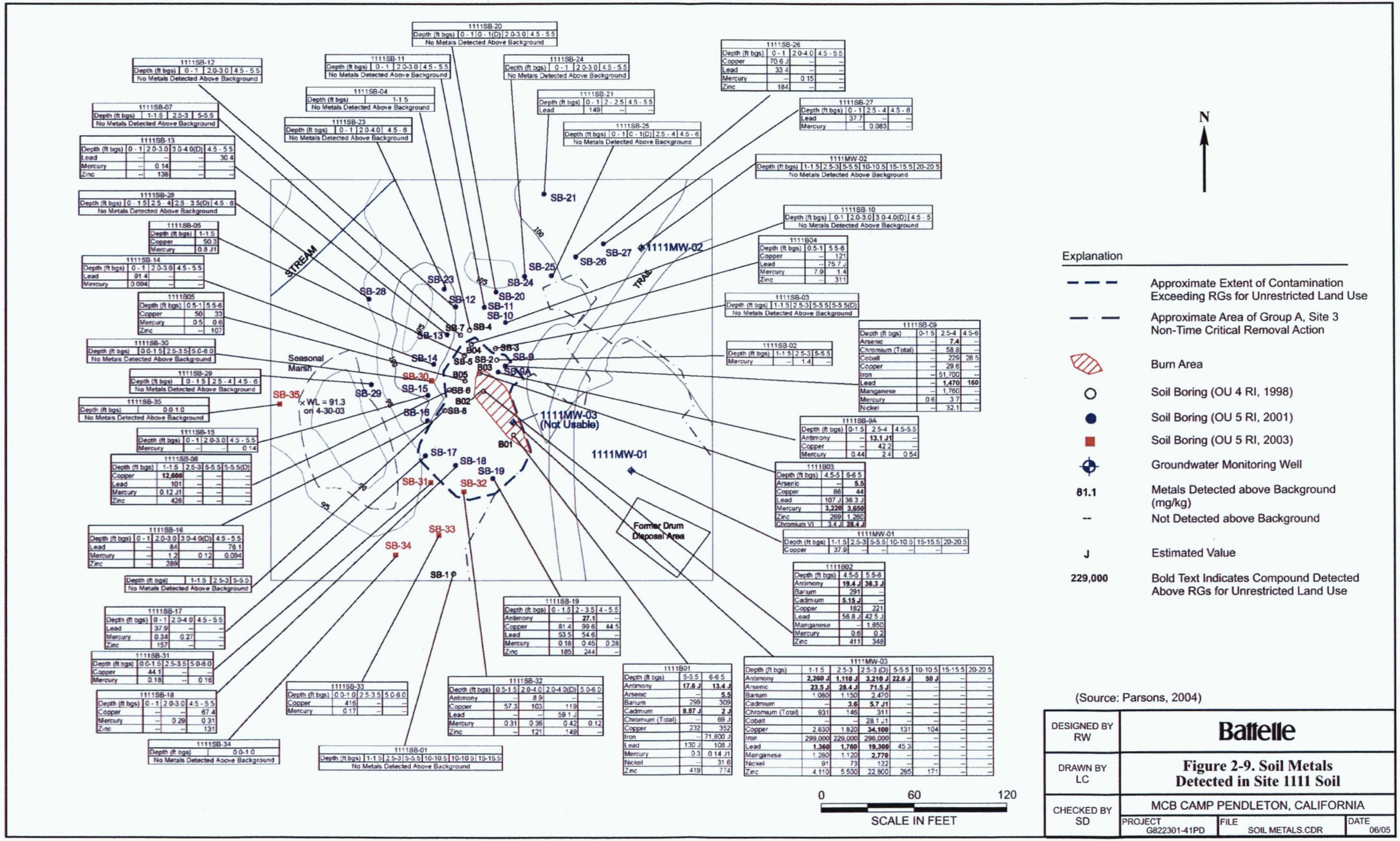


Figure 2-9. Metals Detected in Site 1111 Soil

m,p-xylene, *o*-xylene, and phenanthrene were detected in less than 5 percent of the soil samples in the mixed interval, these chemicals were not eliminated from the HHRA because the detected concentrations were greater than two times their respective maximum MDLs. The OU-5 FS (Parsons, 2005) identified two soil constituents as COCs during the HHRA conducted for a restricted-land use scenario: 2,3,7,8-TCDD, and arsenic.

Site-specific RBCs, protective of human health for an unrestricted (i.e., residential) use scenario, also were calculated and presented in the OU-5 FS (Parsons, 2005) based on the methods and default input assumptions used by U.S. EPA (2004b). Two sets of residential RBCs were presented in the OU-5 FS: one based on toxicity criteria developed by the State of California, and one based on U.S. EPA-recommended toxicity data. Because risk-based concentrations for lead and *p*-isopropyltoluene were not established in the OU-5 FS (Parsons, 2005) but were identified as site COPCs, these soil constituents were screened against the U.S. EPA Region 9 residential preliminary remediation goals (PRGs) (U.S. EPA, 2004b) for this EE/CA. Table 2-2 presents the constituents detected in Site 1111 soil and their respective unrestricted land-use RBCs.

The screening analysis shows that the following 16 constituents are present in soil at Site 1111 at concentrations that are greater than the residential RBCs or background concentration established for the constituent: 2,3,7,8-TCDD, DDD, DDE, DDT, 1,2,4-TMB, PCE, TCE, hexachlorobenzene, antimony, arsenic, cadmium, chromium (hexavalent), copper, lead, manganese, and mercury. Thus, these 16 constituents are considered to be human health COCs at the site for unrestricted land use.

2.3.2 Ecological Risk Assessment

A Tier 1 ecological risk assessment was performed for Site 1111 during the OU-5 RI (Parsons, 2004). The intent of the Tier 1 ERA was to provide a scientific basis for deciding whether the site may be eliminated from concerns over ecological resources (i.e., a no further action decision), whether the site has conditions that may require immediate attention (i.e., precipitating an interim removal/remedial action), or whether any Tier 1 contaminants of potential ecological concern (COPECs) warranted further consideration in the Tier 2 ERA. Contaminants considered during the Tier 1 ERA included inorganics, PAHs, dioxins/furans, pesticides and herbicides, SVOCs, and VOCs.

Concentrations of COPECs in soil were used to estimate exposures to a variety of potential ecological receptors: plants, terrestrial invertebrates, mammals, and birds. In Tier 1, estimated exposures were evaluated against screening-level ecological toxicity values (SEVs), defined as protective concentrations of chemicals that are not associated with adverse ecological effects. Based on exceeding SEVs in Tier 1, Site 1111 did not qualify for a no further action decision. A total of 64 COPECs (17 inorganics, 13 PAHs, dioxins, 10 pesticides, 6 SVOCs, and 18 VOCs) were carried through to the Tier 2 ERA. Based on the refined analysis conducted in the Tier 2 assessment, four constituents are present in soil at concentrations that are predicted to pose a potentially significant hazard to one or more ecological receptors at Site 1111: antimony, mercury, hexachlorobenzene, and 2,3,7,8-TCDD. These four constituents are considered to be contaminants of ecological concern (COECs) at the site.

2.3.3 Potential Threat to Groundwater Quality

In the OU-5 RI, the concentrations of vadose zone soil COPCs at Site 1111 were evaluated using the Designated Level Method (RWQCB, 1989) to identify contaminants present at concentrations that may pose a threat to groundwater via leaching. The most stringent of the federal and California drinking water MCLs were selected as the water quality goals for each soil contaminant analyzed using the Designated Level Method. VLEACH/SUMMERS modeling subsequently was performed in the OU-5 FS for

Table 2-2. Soil COPCs Screened Against Human Health RBCs for Unrestricted Use

Constituent	Maximum Detected Concentration	Background Concentration [a] 0 to 5 ft	Human Health RBCs [b]	
			California Modified Toxicity Data	U.S. EPA Modified Toxicity Data
Volatile Organic Compounds (µg/kg)				
1,2,4-TMB	*220,000*	*N/A*	*94,489.2*	*94,489.2*
1,3,5-TMB	70,800	N/A	78,954.6	78,954.6
Acetone	52	N/A	47,548,407.3	70,392,857.1
4-Methyl-2-pentanone	1,100	N/A	4,224.2	4,224.2
Chloroform	400	N/A	3,180.7	866.3
cis-1,2-DCE	840	N/A	233,047.9	782,142.9
Ethylbenzene	11,000	N/A	161,370.3	161,370.3
Isopropylbenzene	17,000	N/A	115,021.8	115,021.8
m,p-Xylene	46,400	N/A	197,651.6	197,651.6
Methylene chloride	1,200	N/A	15,355.5	31,206.4
MTBE	ND	N/A	110,514.7	110,514.7
Naphthalene	40,600	N/A	540,269.7	262,546.1
n-Propylbenzene	32,700	N/A	112,148.9	112,148.9
o-Xylene	29,000	N/A	168,214.0	168,214.0
p-Isopropyltoluene	34,500	N/A	570,000	570,000
sec-Butylbenzene	25,000	N/A	59,995.2	59,995.2
PCE	*980*	*N/A*	*809.5*	*805.1*
Toluene	4,400	N/A	309,441.5	309,441.5
trans-1,2-DCE	510	N/A	371,832.1	1,564,285.7
TCE	*11,500*	*N/A*	*7,984.2*	*7,984.2*
Semivolatile Organic Compounds (µg/kg)				
bis(2-Ethylhexyl)phthalate	1,200	N/A	162,088.3	34,738.7
Chrysene	500	N/A	3,780.0	62,138.8
Fluoranthene	400	N/A	2,293,638.2	2,293,674.1
Hexachlorobenzene	*1,800*	*N/A*	*270*	*300*
Phenanthrene	1,800	N/A	16,916,615.0	17,202,555.5
Pyrene	400	N/A	1,720,228.6	1,720,255.6
Pesticides (µg/kg)				
DDD	44,500	N/A	2,026.3	2,026.4
DDE	43,000	N/A	2,026.3	2,026.4
DDT	17,000	N/A	2,026.3	2,026.4
Endosulfan I	25	N/A	366,662	366,662
Herbicides (µg/kg)				
Dinoseb	2	N/A	183,311.7	183,314.7
Pentachlorophenol	56	N/A	4,412.4	2,978.4
Metals (mg/kg)				
Aluminum	15,200	20,999	77,039.66	77,039.66
Antimony	*3,210*	*8.8*	*31.29*	*31.29*
Arsenic	*71.5*	*4.6*	*0.06*	*0.39*
Barium	2,470	262	5,417.18	5,417.18
Beryllium	0.38	1.5	153.16	155.27
Cadmium	*8.87*	*2*	*1.67*	*78.00*
Chromium (hexavalent)	*28.4*	*N/A*	*16.29*	*203.56*
Chromium (Total)	931	33	1,428.52	1,428.52
Cobalt	229	13.3	872.42	872.42
Copper	*34,100*	*26.8*	*3,128.57*	*3,128.57*
Lead	*19,300*	*29.1*	*150 [c]*	*400 [c]*
Manganese	*2,770*	*688*	*10,405.81*	*1,812.16*
Mercury	*3,650*	*0.08*	*23.46*	*23.46*

Table 2-2. Soil COPCs Screened Against Human Health RBCs for Unrestricted Use (Continued)

Constituent	Maximum Detected Concentration	Background Concentration [a] 0 to 5 ft	Human Health RBCs [b]	
			California Modified Toxicity Data	U.S. EPA Modified Toxicity Data
Molybdenum	31.7	7.36	391.07	391.07
Nickel	132	22.5	3,638.85	1,564.29
Selenium	0.5	0.8	391.06	391.07
Silver	1.45	1.36	391.07	391.07
Thallium	6	1.4	6.26	6.26
Vanadium	49.8	N/A	78.21	78.21
Zinc	22,800	111	23,464.29	23,464.29
Dioxins/Furans (pg/g)				
2,3,7,8-TCDD Toxicity Eq.	*42,308*	*4.1*	*20*	*17*

N/A = not available.
(a) Santa Margarita Background (SWDIV, 1997).
(b) RBCs calculated in the OU-5 FS (Parsons, 2005).
(c) RBC was set at the U.S. EPA Region 9 PRG for residential soil because RBC was not provided in the OU-5 FS (Parsons, 2005).
Italics indicate that chemical constituent is present at concentrations that exceed one or both human health RBCs.
Source: Parsons (2005).

all VOCs that failed the Designated Level Method, for the purpose of deriving RBCs for Site 1111 soils that are protective of groundwater. U.S. EPA Region 9 tap water preliminary PRGs were used in the absence of MCLs. The VLEACH/SUMMERS evaluations established soil cleanup goals for vadose zone soil contaminants to achieve the groundwater quality goals that were protective of the beneficial use of groundwater at the site.

Based on this analysis, 12 constituents in soil are present at levels determined to be a threat to groundwater: 1,2,4-TMB, 1,3,5-TMB, *cis*-1,2-dichloroethylene (*cis*-1,2-DCE), methylene chloride, naphthalene, PCE, TCE, benzo(a)anthracene, hexachlorobenzene, DDD, DDE, and DDT.

3.0 IDENTIFICATION OF REMOVAL ACTION OBJECTIVES AND REMOVAL GOALS

The cleanup objectives of the proposed removal action, and factors influencing these cleanup objectives, are described in this section. The removal action objectives (RAOs) for Site 1111 soils are identified below and appropriate removal goals (RGs) for soil constituents were formulated to achieve the RAO. The RGs for Site 1111 soils were developed using the RBCs while taking into account the ARARs that potentially influence this removal action.

3.1 Removal Action Objectives

RAOs for surface and subsurface soils at Site 1111 have been established to meet the following broad objectives:

- Reduce human health risk at the site to levels acceptable for unrestricted (i.e., residential) land use so that the site can be closed following the removal action, without institutional controls or long-term monitoring.
- Minimize exposure of chemicals in soil to ecological receptors at concentrations that pose a potentially significant risk.
- Protect the beneficial uses and water quality objectives of the lower Santa Margarita River basin.

3.2 Risk-Based Concentrations for COCs at Site 1111

RBCs were established for soil COCs determined to pose a risk to human health, ecological receptors, and groundwater. A total of 21 COCs were identified for Site 1111 soils, including 16 human health COCs, four COECs (all four COECs also are human health COCs), and 12 COCs that threaten groundwater quality (seven of the 10 groundwater COCs also are human health COCs, and the other five are only groundwater COCs). RBCs originally were presented in the OU-5 FS (Parsons, 2005). The human health RBCs were based on a residential land-use scenario.

3.3 Removal Goals

RGs developed for soil COCs to meet the RAOs are presented in Table 3-1. Soil RGs are based on human health risk, ecological risk, or RBC values established for the protection of groundwater. Human health RGs are based on RBCs for unrestricted (i.e., residential) land use. The ARARs analyses did not cause any of the RBCs to be modified. Although Site 1111 is not a residential area nor will be converted to a residential area in the foreseeable future, the residential RBCs were selected to allow for the eventual closure of the site, without the need for institutional controls or long-term monitoring.

Table 3-1. Site 1111 Removal Goals

Contaminant of Concern	Maximum Concentration	Background Concentration [a] 0 to 5 ft	Removal Goals		
			Human Health RGs [b]	Ecological RGs [c]	RGs Protective of Groundwater [d]
Dioxins/Furans (pg/g)					
2,3,7,8-TCDD TEQ [e]	42,308	–	3.9	44	–
Volatile Organic Compounds (µg/kg)					
1,2,4-TMB	220,000	–	94,489.22	–	575
1,3,5-TMB	70,800	–	–	–	420
cis-1,2-DCE	840	–	–	–	50
Methylene chloride	1,200	–	–	–	33
Naphthalene	40,600	–	–	–	400
PCE	980	–	805.14	–	200
TCE	11,500	–	7,984.21	–	72
Semivolatile Organic Compounds (µg/kg)					
Benzo(a)anthracene	260	–	–	–	200
Hexachlorobenzene	1,800	–	270.18	650	115
Pesticides (µg/kg)					
4,4'-DDD	44,500	–	2026.31	–	2,450
4,4'-DDE	43,000	–	1430.34	–	2,450
4,4'-DDT	17,000	–	1719.87	–	2,450
Inorganics (mg/kg)					
Antimony	3,210	8.8	31.29	12	–
Arsenic	72	4.6	1.8	–	–
Cadmium	9	1.6	1.67	–	–
Chromium (VI)	28	–	16.29	–	–
Copper	34,100	26.8	3128.57	–	–
Lead	19,300	29.1	150 [f]	–	–
Manganese	2,770	688	1812.16	–	–
Mercury	3,650	0.08	23.46	8.5	–

(a) Santa Margarita Background (SWDIV, 1997).
(b) The value selected is the more stringent of the Cal-EPA- and U.S.EPA-modified preliminary removal goals (PRGs).
(c) The value, selected as a site- and chemical-specific ecological PRG, is the lowest of the ecological PRGs for any wildlife receptor.
(d) The value was calculated using VLEACH/SUMMERS model.
(e) Soil samples will be analyzed for dioxin/furan congeners; these concentrations will be used to calculate the 2,3,7,8-TCDD TEQ.
(f) The value is the U.S. EPA Region 9 Residential PRG for lead.
– Indicates that constituent was not identified as a COC during that specific risk assessment.
Source: modified from Parsons (2005).

4.0 IDENTIFICATION AND ANALYSIS OF REMOVAL ACTION ALTERNATIVES

This section describes the screening and evaluation process for soil removal technologies for Site 1111. Removal options are screened in Sections 4.1 and 4.2 based on site-specific factors to eliminate removal technologies that constrain effectiveness, implementability, or cost-effectiveness at the site, and to streamline the technology evaluation process for the remaining technologies. The removal options that are accepted for further evaluation are discussed Section 4.3 based on technology effectiveness, implementability, and cost.

4.1 Soil Removal Technology Screening

A range of contaminant removal options were considered for Site 1111. The removal options considered for soils are summarized in Table 4-1. The purpose of the initial screening was to identify and eliminate removal technologies from further consideration that have site-specific factors that may constrain effectiveness, implementability, or cost-effectiveness at the site. Consequently, several of the options in Table 4-1 that were initially considered for Site 1111 were not included for detailed evaluation as removal alternatives in Section 4.3.

4.1.1 No Further Action

The no further action response is retained for consideration during the development and analysis of alternatives as required by the NCP (40 CFR 300.430[e][6]). The "no further action" response does not provide any additional remediation, containment, or security measures to reduce potential risk to human health or the environment at Site 1111.

4.1.2 Institutional Controls

Institutional controls are administrative and physical actions taken to reduce or eliminate risks to public health and the environment by controlling exposure pathways rather than removing contaminants or controlling and reducing their mobility, toxicity, or volume. Institutional controls such as access restrictions and fencing are typically considered during the initial screening of technologies to limit exposure of potential human receptors. Institutional controls alone would not be effective because soils at Site 1111 pose a risk to ecological receptors and groundwater. The reasonably anticipated future land use at Site 1111 is neither residential nor industrial given its remote location. Thus, land use and access restrictions would effectively limit future development and physical access to the site, eliminating any exposure pathways for humans. Fencing or barriers may be effective in preventing certain ecological receptors (e.g., larger mammals) from accessing the site and contacting site contaminants and also was retained for further evaluation. Institutional controls are readily implementable, and were retained for further consideration in evaluating the soil removal options for this site.

4.1.3 Containment

Containment actions for soil contamination are intended to isolate COCs from potential human and/or ecological contact and to protect unimpacted media by reducing or eliminating the migration of COCs from soil to groundwater or surface water systems. The containment option typically is capping (e.g., asphalt, concrete, or engineered soil cap). At Site 1111, occasional flooding and erosion problems in the area would necessitate an extensive surface water diversion system that makes long-term cap protection and maintenance infeasible. Therefore, this technology was not retained for further consideration in developing remedial alternatives.

Table 4-1. Removal Processes for Contaminated Soils at Site 1111

General Response Action	Technology Type	Process Options	Screening Comments		Cost
			Effectiveness	Implementability	
No further action[(a)]	Not applicable	Not applicable.	Does not effectively protect human health and the environment or comply with ARARs because contaminants exceed risk-based criteria.	Technically simple to implement. Administratively difficult to implement because of potential non-compliance with ARARs. Per NCP requirements, this option was retained for further evaluation.	No cost
Institutional controls	Land use restrictions	Restrictions on land use and groundwater use.	Maintains future land use consistent with risk scenario. Provides limited protection of human health by restricting site activities. Does not reduce the toxicity, mobility, or volume of soil contaminants. Does not provide protection for ecological receptors or groundwater due to contaminant leaching and migration.	Established method for restricting future land use at contaminated sites. Administratively, this option is easy to implement at Site 1111. Some fencing or access controls may be necessary but the alternative is mainly administrative. Future land use to the base would be limited. Due to ease of implementability, this option was retained for further evaluation.	Low
Source isolation plus institutional controls	Containment	Capping of contaminated soil area with asphalt, concrete or engineered soil cap.	Provides limited protection of human health and the environment. Does not reduce the toxicity, mobility, or volume of soil contaminants. May be susceptible to long term erosion.	Conventional technology that is well established and easy to implement. Technology may necessitate an extensive surface water diversion system that makes long-term cap protection and maintenance infeasible.	Moderate
Source removal	Active remediation	Contaminated soil is excavated and removed from the site, and the excavated area is backfilled with clean imported soil and compacted to required standards. Excavation is generally followed by treatment and/or off-site disposal of the contaminated soil.	Provides protection of human health by reducing the volume of contaminants in soils. Provides long-term effectiveness and permanence because contaminant source zone is removed permanently, preventing future contaminant leaching to groundwater.	Conventional technology that is well established in the removal of source zones. Requires off-site disposal of excavated materials from Site 1111. Excavation is feasible at Site 1111 because the vertical extent of contamination is very shallow (average depth 6 ft bgs) and covers a relatively small area (approximately 5,000 ft^2 [0.12 acre]).	Moderate

Table 4-1. Removal Processes for Contaminated Soils at Site 1111 (Continued)

General Response Action	Technology Type	Process Options	Screening Comments		Cost
			Effectiveness	Implementability	
In situ treatment	Active remediation	Soil flushing – in situ soil flushing extracts the contaminants from soil with water or other suitable aqueous solution.	Provides protection of human health and the environment by reducing contaminant concentrations and mass. May not be protective of groundwater. Effectiveness depends on nature of soil.	Conventional technology. May be difficult to treat all of the contaminated soil adequately, and may require follow-up treatment. Because of these limitations, this technology was not retained for further consideration in developing remedial alternatives.	Moderate to high
		Solidification and stabilization – changing the physical properties of the contaminated soil, rendering it solid (with high structural integrity), and making the contaminants less prone to mobilization via leaching.	Provides limited protection of human health and the environment. Does not reduce the toxicity or volume of soil contaminants. Limits the mobility of the contaminants, but it does not reduce contaminant concentrations. Its effectiveness is highly dependent on homogenous mixing.	Conventional technology that is easy to implement. May require long-term maintenance (of greater importance for Site 1111, which may be subject to flooding and erosion), post-cure testing, and implementation of land use restrictions. Because of these limitations, this technology was not retained for further consideration in developing remedial alternatives.	Moderate to high
		Soil vitrification – treats metal-contaminated soil using heat, usually applied through electrical power, to melt the soil at extremely high temperatures.	Provides limited protection of human health and the environment. Does not reduce the toxicity or volume of soil contaminants. Limits the mobility of the contaminants, but it does not reduce contaminant concentrations.	Emerging technology, but easy to implement. May be difficult to treat all of the contaminated soil adequately, and may require follow-up treatment. Because of these limitations, this technology was not retained for further consideration in developing remedial alternatives.	High
		Biological treatment/ phytoremediation – uses plants to remove, transfer, stabilize, or degrade chemical contaminants in soil, sediment, or groundwater.	Provides limited protection of human health and the environment. Reduces the toxicity or volume of soil contaminants. Limits the mobility of the contaminants. Depth limited to extent of root zone.	Emerging technology. May be difficult to treat all of the contaminated soil adequately, and may require follow-up treatment. May require disposal of plants which could bioaccumulate contaminants. Because of these limitations, this technology was not retained for further consideration in developing remedial alternatives.	Moderate to High

Source: Parsons (2005).
(a) The no further action alternative is evaluated, as required under NCP, for comparison purposes only.

4.1.4 Removal and Disposal

A non-time critical removal action provides a mechanism to expedite the CERCLA cleanup process, thus addressing priority risks in a more timely fashion. The removal option considered for soil at Site 1111 is excavation. Under this process option, the contaminated soil is excavated and removed from the site, and the excavated area is backfilled with clean imported soil and compacted to required standards. Excavation is generally followed by treatment and/or disposal of the contaminated soil. This option is particularly suited for source removal. A frequent practice is to excavate and remove "hot spots" in combination with other measures such as containment (i.e., capping) of less-contaminated soils. Worker health and safety concerns weigh heavily in the decision to remove highly toxic or reactive waste material. Other factors considered include contaminant mobility, feasibility of on-site containment or in situ treatment, depth of contamination, and the cost of disposing of the waste or rendering it nonhazardous after excavation.

Air monitoring is usually required for this option to demonstrate the effectiveness of dust suppression measures. Mechanical excavation using heavy equipment such as a backhoe is feasible at Site 1111 because the vertical extent of contamination is very shallow (average depth 6 ft bgs) and covers a relatively small area (approximately 0.12 acre). However, the potential for degradation of sensitive ecological habitat and worker exposure to contamination from implementing this option exists at Site 1111. Appropriate coordination with agencies and implementation of biological monitoring and appropriate mitigation measures would be required. Excavation is readily implementable and was retained for further consideration in evaluating the remedial options for this site.

Excavation of soils at Site 1111 involves disposal of contaminated soil in an appropriate landfill. Two process options were considered: on-base landfilling and off-base landfilling:

- On-base landfilling involves disposal of excavated soil in an on-base landfill. There is currently no on-base CAMU facility at MCB Camp Pendleton, so this option is not feasible and was not retained for further consideration.

- Disposal of excavated soil at an off-base landfill is another option. Waste characterization testing would need to be performed before or during excavation to determine whether the soil exhibits hazardous characteristics that would control the selection of an appropriate disposal facility.

4.1.5 In Situ Treatment

In situ treatment encompasses removal options that are designed to treat contaminated soil in place. The main advantage of in situ treatment is that it allows the soil to be treated without being excavated and transported to an off-site disposal facility, resulting in significant cost savings. However, in situ treatment generally requires longer durations and there is less certainty about the uniformity of treatment because of the variability in soil characteristics and the difficulty in verifying the efficacy of the process. In situ treatment technologies evaluated for contaminated soil at Site 1111 fall into two broad groups: physical/chemical and biological. Physical/chemical treatment is typically cost-effective and can be completed in shorter durations than biological treatment.

4.1.5.1 Physical/Chemical Treatment

This process option uses the physical/chemical properties of the contaminants or contaminated media to destroy (i.e., chemically convert the contaminants to innocuous compounds), separate, or contain the

contamination. Three process options were evaluated that fall in to this category: soil flushing, solidification/stabilization (S/S), and in situ vitrification.

In Situ Soil Flushing

In situ soil flushing extracts contaminants from soil using water or other suitable aqueous solution. Soil flushing uses the contaminant's solubility in liquid to separate it from the soil, and is accomplished by passing the extraction fluid through in-place soils using an injection or infiltration process. Surfactants may be added to the flushing solution to increase the contaminant's solubility. Contaminants are leached with the extraction fluid into the underlying groundwater, which is then extracted and treated above-ground to appropriate standards prior to recycling or release to local publicly owned treatment works (POTWs) or receiving streams (Parsons, 2005). Although this technology appears suitable for treatment of metals in high-soil-permeability conditions similar to those at Site 1111, it has no applicability at this site because it would introduce contaminants into the groundwater. Therefore, this technology was not retained for further consideration in developing remedial alternatives.

In Situ Solidification/Stabilization

In situ S/S reduces the mobility of contaminants in soil through both physical and chemical means. In situ solidification seeks to trap or immobilize contaminants within their "host" medium (i.e., soil), instead of removing them through chemical or physical means. This process option works by changing the physical properties of the contaminated soil, rendering it solid (with high structural integrity), and making the contaminants less prone to mobilization via leaching. The solubility of soil contaminants is reduced by encapsulating the contaminants in a solidifying reagent, thereby reducing the surface area exposed to leaching, and/or by coating the contaminated soil with low-permeability materials (Parsons, 2005).

In situ stabilization treatment processes are intended to convert contaminants to less mobile forms through chemical or thermal interactions. The addition and mixing of stabilizing agents can be achieved either by flooding the ground surface with a liquid stabilizing agent or by allowing it to percolate into the sub-surface and react with the target contaminant. Stabilizing agents in either liquid or dry form also can be introduced and mixed with subsurface soil via auger mixing (U.S. EPA, 1997; Parsons, 2005).

In situ S/S limits the mobility of the contaminants, but it does not reduce contaminant concentrations per se. Its effectiveness is highly dependent on homogenous mixing, which can be difficult to ensure in clay-rich soil environments or where the soil contains significant debris. Grout injection bottom barriers (i.e., impermeable horizontal subsurface barriers) can be used to prevent vertical migration by providing a floor of impermeable material beneath the contaminated soil via directional drilling with forced grout injection. Bottom barriers may be necessary at Site 1111 because groundwater is very shallow (6 to 12 ft bgs). In situ technologies also require long-term maintenance (of greater importance for Site 1111, which may be subject to flooding and erosion), post-cure testing, and implementation of land use restrictions (Parsons, 2005). Because of these limitations, this technology was not retained for further consideration in developing remedial alternatives.

In Situ Vitrification

This technology treats metal-contaminated soil using heat, usually applied through electrical power, to melt the soil at extremely high temperatures (typically 2,900 to 3,600°F). The molten soil forms a stable glass and crystalline structure with very low leaching characteristics that immobilizes the inorganic contaminants by entrapping them or chemically incorporating them in the melt. Because this technology does not destroy many of the metal contaminants but rather traps them inside the matrix, it is often applied to highly concentrated characteristic hazardous waste to meet applicable disposal requirements. There are several disadvantages with this technology. The high temperatures associated with this process produce emissions of toxic vapor from relatively volatile metals (i.e., mercury and lead) that must be

captured and treated. Also, the resulting solidified matrix may hinder future site use and necessitate the use of site access restrictions, implementation entails long-term maintenance, and the technology is energy intensive and costly (Parsons, 2005). Because of these concerns, this technology is impractical for application at Site 1111 and was therefore excluded from further consideration.

4.1.5.2 Biological Treatment (Phytoremediation)

Phytoremediation is an emerging technology that uses plants to remove, transfer, stabilize, or degrade chemical contaminants in soil, sediment, or groundwater. There are various applications of phytoremediation technologies; the most appropriate application to Site 1111 is enhanced rhizosphere biodegradation, which takes place in the soil immediately surrounding plant roots. Natural substances released by plant roots supply nutrients to soil microorganisms enhancing their biological activity. Plant roots also loosen the soil and then die, leaving paths for transport of water and aeration. This process facilitates the movement of soil moisture to the surface zone.

Research has shown that plants can be used to treat most classes of compounds including metals. Plant species are selected on the basis of their potential to evapotranspirate groundwater, the degradative enzymes they produce, their growth rate and yield, the depth of their root zone, and their ability to bioaccumulate contaminants. Although certain plants allow uptake from deeper zones, phytoremediation is best suited for use in soils that are within 2 to 3 ft bgs and are contaminated with intermediate concentrations of organic waste (Parsons, 2005).

For Site 1111, phytoremediation was not judged to be implementable due to limited vertical effectiveness of the technology, the few demonstrated successful applications of this technology to treat the range of COCs at the site at the observed concentrations, and the fact that it will not eliminate ecological exposure to COCs. Also, it may increase contaminant mobility via plant uptake, making COCs more available and allowing continued long-term exposure to ecological receptors. Also, the concept of excavating the soil to allow use of phytoremediation is not considered cost-effective because the cost of excavation, placement, maintenance, design, construction, and operation of an ex situ phytoremediation treatment system would rival the cost of excavation and disposal. For these reasons, phytoremediation was excluded from further consideration for this site.

4.2 Soil Removal Technology Screening Results

The removal action for Site 1111 will involve implementation of an alternative for vadose zone soils. The following removal technology options were selected from the screening process and are evaluated in detail in Section 4.3 to formulate a removal alternative for Site 1111 soils:

S1 – No further action (as required under the NCP)
S2 – Institutional controls
S3 – Excavation of unsaturated source zone soil, backfilling with clean soil, and off-site disposal of excavated soil.

4.3 Detailed Evaluation of Soil Removal Technologies

In this section, three removal technologies are evaluated in detail based on their effectiveness at achieving RGs, implementability, and cost. For comparison, the NFA alternative also is evaluated as required under the NCP.

To evaluate effectiveness, consideration was given to the overall protection of human health and the environment, compliance with ARARs and other guidance, and both the long-term and short-term effective-

ness of the alternative. Appendix A provides the ARARs evaluation conducted to support this removal action. Evaluation of the implementability of each alternative included consideration of the technical feasibility, commercial availability, administrative feasibility, and U.S. EPA, state, and public acceptance. U.S. EPA, state, and public input will be included as a result of the review process. U.S. EPA acceptance with state concurrence requires the responsible party (Navy) to address the U.S. EPA's comments for each alternative. The U.S. EPA's acceptance may not be completed until public comments on the EE/CA are received. Furthermore, the U.S. EPA as the regulatory agency must concur with the highest ranked alternative presented in the EE/CA. The acceptance of an alternative will be fully addressed during the public comment period and during preparation of the AM. This EE/CA was made available for public comment; however, no comments were received.

The cost evaluation is based upon estimates for capital costs and operations and maintenance (O&M) costs. Capital costs include the costs for design, construction, equipment, mobilization, and decommissioning. O&M costs include equipment rental, labor, analytical costs, transportation, and disposal fees. Appendix B shows itemized costs for the three removal technology alternatives. The following subsections present the three post-screening removal technology evaluations for soils at Site 1111.

4.3.1 S1 – No Further Action

This section provides a description of the factors influencing the evaluation of the no further action alternative.

4.3.1.1 Description

The NCP (40 CFR 300.430[e][6]) requires that a no further action alternative be evaluated. Under this alternative, no action would be taken to control or clean up the soil contamination at Site 1111 to reduce potential risks to human health and the environment. The no further action alternative involves no removal of soils and results in no disturbance to the existing environment.

4.3.1.2 Effectiveness

The risks associated with the no further action alternative were evaluated in the baseline human health and ecological risk assessments completed during the RI (Parsons, 2004) and FS (Parsons, 2005). This alternative would not provide actions or controls to reduce existing contaminant concentrations or risks to human health or the environment. The site waste is a long-term, significant, and continuous source of pollutants to groundwater that may limit the base's ability in the future to access and/or develop water resources in the vicinity and downgradient of Site 1111. As a result, the reliability and adequacy of actions or controls is not evaluated for no further action. No further action is not considered to provide long-term or short-term effectiveness and permanence because contaminated material would remain at the site and because it does not adhere to the ARARs identified for this removal action. The site is located in the floodplain and no further action also does not prevent the possible erosion of existing contaminated soils.

4.3.1.3 Implementability

The no further action alternative is technically easy to implement, but is unacceptable because it does not protect human health and the environment.

4.3.1.4 Cost

No costs are associated with Alternative S1.

4.3.2 S2 – Institutional Controls in the Form of Land Use Restrictions

This section provides a description of the evaluation of implementing institutional controls in the form of access and land use restrictions.

4.3.2.1 Description

This alternative implements institutional controls at Site 1111 to reduce the risk to human health and the environment by controlling and monitoring exposure pathways rather than removing or controlling the risk source. Institutional controls refer to measures other than engineering controls and treatment technologies. The institutional controls in Alternative S2 include implementing restrictions on the site's future development and use, as well as periodic site inspection/monitoring of the site to prevent unauthorized use.

The intent of the land use restrictions is to limit activities that would increase the potential for exposure of receptors to buried materials. Future use of Site 1111 for residential or industrial purposes would be precluded by enforcing these land use restrictions. Details of the site's institutional controls would be incorporated into the land use control documents. To limit erosion and reduce the potential for exposure of human and ecological receptors to the buried materials, the site would be inspected periodically during the rainy season for evidence of erosion. If required, measures would be implemented to limit or control site erosion.

Alternative S2 represents minimal administrative actions and physical measures to restrict site access in order to temporarily reduce and control exposure risks, but it does not involve any active remediation of the contaminated soil to eliminate exposure risk. Monitoring is expected to continue as long as wastes remain at the site.

If institutional controls, or land use controls, are chosen as the selected remedy for this site, a detailed description of the institutional controls or land use controls will need to be included in a subsequent decision document. The DON memo titled *Monitoring and Enforcement of Land Use Controls* (DON, 2003) provides specific items to be included in these decision documents, including listing the parties responsible for enforcing the land use controls, and the need for five-year reviews.

4.3.2.2 Effectiveness

This alternative would be effective in controlling potential human exposure to contaminated soils and would limit future site development. Alternative S2 would require long-term maintenance and would provide a degree of effectiveness through limiting exposure and site uses. However, the site waste is a long-term, significant, and continuous source of pollutants to groundwater that may limit the base's ability in the future to access and/or develop water resources in the vicinity and downgradient of Site 1111. Further, given the site's location within the floodplain, the potential for flooding to expose contaminated soils, and the risk posed to ecological receptors by baseline conditions, this alternative does not provide long-term effectiveness for human or ecological receptors and adhere to the ARARs identified for this removal action.

4.3.2.3 Implementability

Institutional actions are readily implementable. Modifications to the land use controls documents per United States Department of Defense (DoD) guidance are administrative in nature. The base would have primary responsibility for implementing this alternative and possesses the authority and capability to establish appropriate safeguards and to monitor and enforce compliance. Existing staff within the base Environmental Security Office coordinate all on-base construction activities to ensure appropriate environmental review. Institutional controls for IR sites are maintained on a central Geographic Information

System (GIS) that is readily accessible. Furthermore, the CERCLA 5-year review process provides an additional level of review to ensure that the site is not used inappropriately.

Implementation of Alternative S2 would require coordination with the United States Fish and Wildlife Service (USFWS) to ensure that this alternative would be protective of ecological receptors and complies with requirements of the Endangered Species Act. Based on the previously performed ERA, it is unlikely that these agencies would allow this alternative to be implemented because it would not be protective of ecological receptors.

4.3.2.4 Cost

The total cost of Alternative S2 is estimated to be $475,000. This cost covers the administrative costs for implementing use restrictions, future inspection/reporting the site surface, and 5-year review reporting. If institutional controls were implemented, there would be indirect costs associated with the base not being able to use the property for training and other purposes. This potential loss of land use is not quantified in this document, but is considered as a factor in evaluating implementability of institutional controls as a removal alternative. A cost estimate, including inspection/reporting costs, is provided in Appendix B.

4.3.3 S3 – Soil Excavation, Backfill, and Off-Base Disposal

This section provides a description of the evaluation of soils excavation, backfilling with clean soil, and off-base disposal of excavated soils.

4.3.3.1 Description

Alternative S3 addresses remediation of contaminated soils exceeding RGs through excavation and off-base disposal. The following elements are associated with Alternative S3:

- Confirmation sampling and analysis of excavation areas
- Excavation of impacted soil
- Temporary storage of excavated soil stockpiles
- Import and compaction of backfill material
- Sampling and analysis of soil stockpiles for waste characterization
- Transportation of the excavated soil to an off-base disposal facility
- Site restoration.

Confirmation Sampling

Prior to the excavation, confirmation samples will be collected at the estimated lateral limits and target depth of the contaminated soil. Confirmation samples will be analyzed for the COCs presented in Table 3-1 and the results will be compared to the applicable RGs. Approximately one confirmation sample would be collected from each 25 ft by 25 ft (600 ft^2) area of the excavation. If the confirmation samples do not contain concentrations of COCs above RGs, then the excavation extent will be considered adequate to meet the RAOs. After the completion of the excavation, it will only be necessary to verify that the vertical and lateral limits of the excavation meet the extent, as defined by the confirmation samples.

Excavation of the Impacted Soil

Within this 0.12-acre area, the volume of material exceeding the RGs, approximately 1,100 yd^3, is the amount of soils that would require excavation from Site 1111. The excavation area is irregularly shaped, and measures roughly 80 by 70 ft and extends to a depth of approximately 6 ft bgs. Heavy earthmoving

equipment such as a track-mounted excavator and track- or wheeled-loaders would be used to excavate the impacted soil within the lateral limits. During soil removal, the excavation would progress vertically and laterally to remove the areas of identified soil contamination exceeding the RGs. The excavation sidewalls would be sloped at 1.5:1 (horizontal:vertical) to maintain slope stability and avoid the use of shoring.

Temporary Storage of Excavated Soil Stockpiles

During the removal action, the excavation and stockpile areas would be delineated with barricades, caution tape, and warning signs to restrict unauthorized access to these areas. Potential exposure and protection procedures for site workers would be addressed in a site-specific health and safety plan. The risk of exposure for site personnel to soil contaminants would be minimized by proper selection of personal protective equipment (PPE); establishing support, contaminant reduction, and exclusion zones; application of suppressants to reduce dust emissions in the excavation and at the stockpile areas; and monitoring dust using direct-reading instruments.

A medium-sized tracked excavator (Caterpillar® 235 or equivalent) would be used to excavate the soil and place it in small stockpiles adjacent to the working face of the excavation. Large capacity front-end loaders then would transfer the soil from the stockpile to awaiting 23-ton end dump trucks for transport and disposal. Plastic sheeting would be required to protect the ground surface beneath the loading area to protect underlying soils. The stockpiles would be periodically wetted and regularly monitored to ensure control of fugitive dust emissions. The water applied during dust control activities would be applied so as to eliminate the potential for erosion. Stockpiles would be in continuous motion during excavation and loading of materials for disposal. However, at the end of each day, stockpiles would be covered with Visqueen (plastic) sheeting and secured with sand bags. Prior to transport, composite stockpile samples would be collected and the analytical results then would be used to characterize and classify the waste.

Import and Compaction of Backfill Material

A licensed land surveyor would survey the final spatial limits of the excavation after confirmation sampling and analysis and prior to placement and compaction of backfill. After excavation and confirmation sampling is completed on a few contiguous grids, placement of backfill and compaction would be initiated. To the maximum extent possible, backfill and compaction would be performed concurrently with excavation and confirmation sampling. Prior to placement of backfill, the exposed bottom of the excavation would be moisture conditioned and the excavation backfilled with imported clean soil. All backfill material would be placed in lifts, moisture conditioned, and compacted. Compaction tests would be performed during the backfill operation to document the percent relative compaction of the soil.

Sampling and Analysis of Soil Stockpiles for Waste Characterization

It will be necessary to classify all excavated waste; therefore, soil stockpiles will be sampled. Stockpile samples will be subject to appropriate testing and analyses to determine the waste classification of the soil for disposal purposes. Waste classification tests for California facilities include the Toxic Characteristic Leaching Procedure (TCLP) and the California Waste Extraction Test (WET) to determine if the waste is RCRA-hazardous or California-hazardous, respectively. Both the TCLP and WET stipulate concentration limits for numerous chemical constituents; however, the tests can be performed for only selected constituents (i.e., rather than the entire list of regulated constituents) if site data or prior knowledge of site operations are available to justify an abbreviated analytical list. Therefore, all available soil analytical results from previous investigations at Site 1111 were compiled and evaluated to determine the appropriate analyses to perform on stockpile samples.

Based on this evaluation, TCE, pesticides (4,4′-DDD, 4,4′-DDE, and 4,4′-DDT), and several metals are present in Site 1111 soil at levels that could cause the material to be classified as either RCRA-hazardous

Table 4-2. Criteria Necessary to Classify Stockpiled Waste

Chemical	California-Hazardous Criteria		RCRA-Hazardous Criteria
	TTLC (mg/kg)	STLC (mg/L)	TCLP (mg/L)
4,4'-DDD	1	0.1	---
4,4'-DDE	1	0.1	---
4,4'-DDT	1	0.1	---
Antimony	500	15	---
Arsenic	500	5	5
Barium	10,000	100	100
Chromium	500	5	5
Copper	2,500	25	---
Lead	1,000	5	5
Mercury	20	0.2	0.2
TCE	2,040	204	0.5
Zinc	5,000	250	---

or California-hazardous and thus will be included for the stockpile testing. Table 4-2 summarizes the screening criteria necessary to classify stockpiled waste.

Transportation of the Excavated Soil to an Off-Base Disposal Facility

For estimating purposes, it is assumed that all RCRA-hazardous and California-hazardous soil would be transported, under Uniform Hazardous Waste Manifest, to Waste Management's Kettleman Hills Facility in Kettleman City, CA for treatment and/or disposal. If, based on results of stockpile samples, a portion of the material is determined to be nonhazardous, this soil would be disposed of at a Class III landfill permitted to accept the burn ash soil. All required placards would be placed on vehicles prior to leaving the site. All federal and California Department of Transportation (DOT) guidelines and regulations would be followed. Each transport truck is expected to haul permanently 18 yd^3 (23 tons) of soil to the disposal facility. To ensure that trucks do not exceed the public highway weight limits, calibrated portable scales would be placed on site and operated by a certified weigh master. An average rate of 15 minutes per transport truck is estimated for loading, weighing, and tarping; therefore, 32 trucks could be loaded in each 8-hour shift. Transportation and waste profiling of the excavated soil would occur concurrently with excavation.

Site Restoration

The excavation would be backfilled to the original surface contours, surveyed, and revegetated with native flora to restore habitat and to minimize erosion.

4.3.3.2 Effectiveness

This alternative would provide a high degree of effectiveness and permanence because contaminants are removed from the site and the contaminated soil is replaced with clean, imported soil. The excavation of contaminated soil provides a permanent solution for protecting human receptors and results in an adequate and reliable reduction of exposure pathways. Removal and off-site disposal of the contaminated soil would result in acceptable levels of residual soil contamination from both a human and ecological perspective, while discontinuing the threat to groundwater posed by vadose zone soil contaminants. Further, Alternative S3 adheres to the ARARs identified for this removal action.

4.3.3.3 Implementability

Alternative S3 can be implemented easily because of the mature nature of technology. Several contractors can provide the necessary equipment, materials, and labor to excavate and dispose of the contaminated soil. Licensed disposal facilities capable of accepting the contaminated soil currently exist within the State of California. Because the majority of the impacted soil would be permanently removed from the site, future soil remedial/removal activities are not expected to be necessary. Collecting and screening confirmation samples during excavation would be used to evaluate the effectiveness of soil excavation. Implementation of Alternative S3 would require coordination with the USFWS to ensure that this alternative would be protective of ecological receptors and complies with requirements of the Endangered Species Act. In addition, cultural resources coordination may be required. This review process would require implementation of appropriate mitigation measures to minimize habitat disruptions during earth-moving activities, including scheduling limitations on excavation work; performance of short-term biological monitoring prior to, during, and after construction activities; and long-term biological monitoring and habitat restoration measures.

4.3.3.4 Cost

The cost for Alternative S3 is estimated at $699,000. A cost estimate, including inspection/reporting costs, is provided in Appendix B.

5.0 COMPARATIVE ANALYSIS OF REMOVAL ALTERNATIVES

This section compares the alternatives analyzed in Section 4.0 and specifies the basis for rejection of an alternative. Soil removal action alternatives are evaluated and compared based on the effectiveness, implementability, and cost criteria. The soil removal actions being considered include S1 – no further action; S2 – institutional controls in the form of access and land use restrictions; and S3 – excavation, backfilling, and off-site disposal of remaining soil that does not meet RGs.

5.1 Effectiveness of Soil Removal Alternatives

Alternative S1 is rated low for long-term effectiveness and permanence because no measures or controls are associated with this alternative. Alternative S2 requires long-term maintenance and provides a degree of long-term effectiveness through limiting exposure and site uses. However, Alternative S2 does not limit adverse affects to ecological receptors and site groundwater. Furthermore, both Alternatives S1 and S2 also do not adhere to ARARs identified for Site 1111. Alternative S3 provides the greatest degree of long-term effectiveness and permanence because it involves removal of the contaminated soils from the area and backfilling of the excavation with clean import soil. The measures and controls associated with alternative S3 effectively reduce the potential for future human exposure, and require no further actions (e.g., institutional controls). In addition, Alternative S3 adheres to the ARARs identified for Site 1111.

5.2 Implementability of Soil Removal Alternatives

This criterion is not rated for Alternative S1 because no activities would be conducted under this alternative. Alternatives S2 and S3 are readily implementable and involve commonly performed removal operations. Alternative S2 is considered easier to implement because activities are largely administrative. However, given that the base mission is to support training, any area with a land use restriction would limit that function and this potential loss of land. Consequently, Alternative S2 is rated moderate. Alternative S3 uses standard equipment and labor skills and is readily implementable. Alternative S3 is ranked high because all components of this alternative are readily implementable. The primary limitation to this alternative is short-term exposure during the excavation, which may be minimized with engineered controls and protective equipment.

5.3 Cost of Soil Removal Alternatives

No cost is associated with Alternative S1. Alternative S2 is less expensive than Alternative S3, with an estimated cost of $475,000. Alternative S3 is the most expensive remedial alternative for Site 1111, at a cost of approximately $699,000.

5.4 Summary of Comparative Analysis

The results of the comparative analysis for Site 1111 soil are summarized in Table 5-1.

Table 5-1. Summary of Comparative Analysis of Remedial Alternatives

Criterion	S1	S2	S3
Long-Term Effectiveness and Permanence	Low	Low	High
Implementability	Not Rated	Moderate	High
Cost ($ million)	0	0.475	0.70

6.0 RECOMMENDED REMOVAL ACTION ALTERNATIVE

This EE/CA was performed in accordance with current U.S. EPA (1993) and U.S. Navy guidance for a non-time critical removal action under CERCLA. The purpose of this EE/CA was to identify and analyze alternative removal actions to address soil contamination at Site 1111, MCB Camp Pendleton.

Several soil removal action alternatives were screened and eliminated (see Section 4.0 and Table 4-1) based on site-specific factors that constrain effectiveness, implementability, and/or cost-effectiveness at the site. The eliminated technologies for soils included containment and in situ and ex situ treatment options. These alternatives were not considered to be effective for removing both inorganic and organic COCs at Site 1111. In addition, they generally were not cost-effective compared to alternatives that were chosen for further analyses.

The preliminary screening yielded the following three removal action alternatives that were subjected to further evaluation:

S1 – No further action
S2 – Institutional controls
S3 – Soil excavation and disposal.

These three alternatives are ranked in Section 5.0 (see Table 5-1) based on their effectiveness, implementability, and cost.

Based on the evaluation process for the three soil removal alternatives, the recommended removal action for Site 1111 is Alternative S3 – soil excavation, backfilling with clean soil, and off-site disposal of excavated soil. This alternative is effective, readily implementable, and will achieve the RAOs and meet the RGs for Site 1111 soils. In addition, this option provides long-term protection of human health and reduces risk to ecological receptors and groundwater. If Alternative S3 is implemented at Site 1111, the site will be suitable for unrestricted use and will need no further removal/remedial actions to mitigate risks originating from site soils. The no further action alternative (Alternative S1) will not achieve RAOs, and institutional controls (Alternative S2) were judged to limit land use and not provide protection for ecological receptors and groundwater.

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APPENDIX A

Applicable or Relevant and Appropriate Requirements (ARARs)

CONTENTS

TABLES

A1 INTRODUCTION

This appendix identifies federal and State of California applicable or relevant and appropriate requirements (ARARs) from the body of regulations, requirements, and guidance that govern remedial actions, and sets forth the Department of the Navy (DON) determinations regarding those potential ARARs for the removal action alternatives at Site 1111, Marine Corps Base (MCB) Camp Pendleton.

A1.1 Summary of CERCLA and NCP Requirements

Section 121(d) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA, 42 USC §9621[d]), as amended, states that remedial actions at CERCLA sites must attain (or the decision document must justify the waiver of) any federal or more stringent state environmental standards, requirements, criteria, or limitations determined to be legally applicable or relevant and appropriate. Although Section 121 of CERCLA does not itself expressly require that CERCLA removal actions comply with ARARs, the United States Environmental Protection Agency (U.S. EPA) has promulgated a requirement in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) mandating that CERCLA removal actions "...shall, to the extent practicable considering the exigencies of the situation, attain applicable or relevant and appropriate requirements under federal environmental or state environmental or facility siting laws" (40 CFR §300.415[j]). It is DON policy to follow this requirement. Certain specified waivers may be used for removal actions, as is the case with remedial actions.

Applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address the response actions to be taken at a CERCLA site. The requirement is applicable if the jurisdictional prerequisites of the standard show a direct correspondence when objectively compared to the conditions at the site. An applicable federal requirement is an ARAR. An applicable state requirement is an ARAR only if it is more stringent than federal ARARs.

If the requirement is not legally applicable, then the requirement is evaluated to determine whether it is relevant and appropriate. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, although not applicable, address problems or situations similar to the circumstances of the proposed response action and are well suited to the conditions of the site (U.S. EPA, 1988 and 1989). A requirement must be determined to be both relevant and appropriate in order to be considered an ARAR.

The criteria for determining relevance and appropriateness are listed in 40 CFR §300.400(g)(2) and include the following:

- The purpose of the requirement and the purpose of the CERCLA action;
- The medium regulated or affected by the requirement and the medium contaminated or affected at the CERCLA site;
- The substances regulated by the requirement and the substances found at the CERCLA site;
- The actions or activities regulated by the requirement and the response action contemplated at the CERCLA site;

- Any variances, waivers, or exemptions of the requirement and their availability for the circumstances at the CERCLA site;
- The type of place regulated and the type of place affected by the release or CERCLA action;
- The type and size of structure or facility regulated and the type and size of structure or facility affected by the release or contemplated by the CERCLA action; and
- Any consideration of use or potential use of affected resources in the requirement and the use or potential use of the affected resources at the CERCLA site.

According to CERCLA ARARs guidance (U.S. EPA, 1988), a requirement may be "applicable" or "relevant and appropriate," but not both. Identification of ARARs must be done on a site-specific basis and involve a two-part analysis: first, a determination of whether a given requirement is applicable; then, if it is not applicable, a determination of whether it is both relevant and appropriate. If the analysis determines that a requirement is both relevant and appropriate, the requirement must be complied with as if it were applicable (U.S. EPA, 1988).

Tables included in this appendix present each ARAR determined to apply at Site 1111. The tables are organized with an initial determination of ARAR status (i.e., either applicable or relevant and appropriate). For the determination of relevance and appropriateness, the pertinent criteria were examined to determine whether the requirements addressed problems or situations sufficiently similar to the circumstances of the release or response action contemplated, and whether the requirement was well suited to the site. A negative determination of relevance and appropriateness indicates that the requirement did not meet the pertinent criteria. Negative determinations are documented in the tables of this appendix, and are discussed in the text only for specific cases.

To qualify as a state ARAR under CERCLA and the NCP, a state requirement must be:

- A state law or regulation,
- An environmental or facility siting law or regulation,
- Promulgated (of general applicability and legally enforceable),
- Substantive (not procedural or administrative),
- More stringent than federal requirements,
- Identified in a timely manner, and
- Consistently applied.

To constitute an ARAR, a requirement must be substantive. Therefore, only the substantive provisions of requirements identified as ARARs in this analysis are considered to be ARARs. Permits are considered to be procedural or administrative requirements. Provisions of generally relevant federal and state statutes and regulations that are determined to be procedural or nonenvironmental, including permit requirements, are not considered to be ARARs. CERCLA Section 121(e)(1), 42 USC §9621(e)(1), states that "No Federal, State, or local permit shall be required for the portion of any removal or remedial action conducted entirely on-site, where such remedial action is selected and carried out in compliance with this section." The term on-site is defined for purposes of this ARARs discussion as "the areal extent of contamination and all suitable areas in very close proximity to the contamination necessary for implementation of the response action" (40 CFR §300.5).

Nonpromulgated advisories or guidance issued by federal or state governments are not legally binding and do not have the status of ARARs. However, such requirements may be useful, and are "to be

considered" (TBC; 40 CFR §300.400[g][3]). TBC requirements complement ARARs but do not override them. They are useful for guiding decisions regarding cleanup levels or methodologies when regulatory standards are not available.

In accordance with U.S. EPA (1988) guidance, ARARs generally are divided into three categories: chemical-specific, location-specific, and action-specific requirements. These classifications were developed to aid in the identification of ARARs, as some ARARs do not fall precisely into one group or another. ARARs are identified on a site-specific basis for remedial actions where CERCLA authority is the basis for cleanup.

Identification of potential state ARARs for Site 1111 was initiated through DON requests that the California Environmental Protection Agency (Cal-EPA) Department of Toxic Substances Control (DTSC) identify potential state ARARs, an action described in more detail in Section A1.2.3. State ARARs that have been identified for Site 1111 are discussed below.

A1.2 Methodology Description

The method of identifying and evaluating potential federal and state ARARs is described in this subsection.

A1.2.1 General

As the lead federal agency, the DON has primary responsibility for identifying federal ARARs at Site 1111. In accordance with the definition of the term *on-site* in 40 CFR § 300.5, the on-station areas that are part of this action include the impacted soil at Site 1111 that will be excavated and disposed of off-site. In preparing this ARARs analysis, the DON undertook the following measures, consistent with CERCLA and the NCP:

- Identified federal ARARs for each response action alternative addressed in the EE/CA (Battelle, 2005), taking into account site-specific information for Site 1111;
- Reviewed potential state ARARs identified by the state to determine whether they satisfy CERCLA and NCP criteria that must be met in order to constitute state ARARs;
- Evaluated and compared federal ARARs and their state counterparts to determine whether state ARARs are more stringent than the federal ARARs; and
- Reached a conclusion as to which federal and state ARARs are the most stringent and/or "controlling" ARARs for each alternative.

A1.2.2 Identifying and Evaluating Federal ARARs

The federal government implements a number of environmental statutes that are the source of potential federal ARARs, either in the form of the statutes or regulations promulgated there-under. Examples include the Resource Conservation and Recovery Act (RCRA), the Clean Water Act, the Safe Drinking Water Act, the Toxic Substances Control Act, and their implementing regulations. See NCP preamble at 55 Federal Register 8764-8765 (1990) for a more complete listing.

The proposed Site 1111 response action and alternatives were reviewed against all potential federal ARARs, including but not limited to those set forth at 55 Federal Register 8764-8765 (1990), in order to

determine if they were applicable or relevant and appropriate using the CERCLA and NCP criteria and procedures for ARARs identification by lead federal agencies.

A1.2.3 Identifying and Evaluating State ARARs

The process of identifying and evaluating state ARARs by the state and the DON is described in this subsection.

Solicitation of State ARARs Under NCP

U.S. EPA (1988 and 1989) guidance recommends that the lead federal agency consult with the state when identifying state ARARs for remedial actions. In essence, the CERCLA/NCP requirements for remedial actions at 40 CFR §300.515 provide that the lead federal agency request that the state identify chemical- and location-specific state ARARs upon completion of site characterization. The requirements also provide that the lead federal agency request identification of all categories of state ARARs (chemical-, location-, and action-specific) upon completion of identification of remedial alternatives for detailed analysis. The state must respond within 30 days of receipt of the lead federal agency requests. The remainder of this subsection documents the DON's efforts to date to identify and evaluate state ARARs.

Chronology of Efforts to Identify State ARARs

The following chronology summarizes the DON efforts to obtain state assistance in identifying state ARARs, and the use of previously identified ARARs, for the potential response actions at MCB Camp Pendleton OU-5 sites. DON efforts are consistent with Section 7.6 of the FFA for MCB Camp Pendleton. Key correspondence between the DON and the state agencies relating to this effort has been included in the Administrative Record.

Identification of state ARARs for Site 1111 has been directly or indirectly addressed in various documents as discussed below. Potential state ARARs for Site 1111 were submitted in the draft OU-4 RI/FS (Parsons, 1999) based upon past communications with the state. Alternatives for Site 1111 were as follows:

- S1 – No further action (as required under the NCP)
- S2 – Institutional controls
- S3 – Excavation of unsaturated source zone soil, backfilling with clean soil, and off-site disposal of excavated soil.

The DON received state comments on the draft OU-4 RI/FS from the DTSC, and responded to agency comments on May 26, 2000. The responses were reviewed at the 36th FFA project managers meeting for MCB Camp Pendleton, held August 2, 2000.

The state submitted a response to the request for ARARs in their comments on the OU-4 FS. These also addressed soil sites at Camp Pendleton and would therefore provide some precedent for similar soil sites such as Site 1111.

These previous efforts and experience in identifying state ARARs are considered sufficient for the Site 1111 removal action. Any further ARARs-related comments received by the agencies on this Action Memorandum will be addressed and incorporated into the Final EE/CA and Action Memorandum.

A1.3 Other General Issues

RCRA is a federal statute passed in 1976 to meet four goals: the protection of human health and the environment, the reduction of waste, the conservation of energy and natural resources, and the elimination of the generation of hazardous waste as expeditiously as possible. The Hazardous and Solid Waste Amendments (HSWA) of 1984 significantly expanded the scope of RCRA by adding new corrective action requirements, land disposal restrictions, and technical requirements. RCRA, as amended, contains several provisions that are potential ARARs for CERCLA sites.

Substantive RCRA requirements are applicable to response actions on CERCLA sites if the waste is a RCRA hazardous waste, and either:

- The waste was initially treated, stored, or disposed of after the effective date of the particular RCRA requirement; or
- The activity at the CERCLA site constitutes treatment, storage, or disposal, as defined by RCRA (U.S. EPA, 1988).

The preamble to the NCP indicates that state regulations that are components of a federally authorized or delegated state program are generally considered federal requirements and potential federal ARARs for the purposes of ARARs analysis (55 Federal Register 8666, 8742 [1990]). The State of California received approval for its base RCRA hazardous waste management program on July 23, 1992 (57 Federal Register 32726 [1992]). The State of California "Environmental Health Standards for the Management of Hazardous Waste," set forth in 22 CCR div. 4.5 were approved by U.S. EPA as a component of the federally authorized State of California RCRA program. On September 26, 2001, California received final authorization of its revised State Hazardous Waste Management Program by the U.S. EPA (63 Federal Register 49118 [2001]).

Therefore, the regulations of 22 CCR div. 4.5 are a source of potential federal ARARs for CERCLA response actions. The exception is when a state regulation is "broader in scope" than the corresponding federal RCRA regulations. In that case, such regulations are not considered part of the federally authorized program or potential federal ARARs. Instead, they are purely state law requirements and potential state ARARs.

The U.S. EPA's July 23, 1992 notice approving the State of California RCRA program (57 Federal Register 32726 [1992]) specifically indicated that the state regulations addressed certain non-RCRA, state-regulated hazardous wastes that fell outside the scope of federal RCRA requirements. 22 CCR div. 4.5 requirements would be potential state ARARs for such non-RCRA, state-regulated wastes.

A key threshold question for the ARARs analysis is whether or not the contaminants at Site 1111 constitute federal hazardous waste as defined under RCRA and the state's authorized program or qualify as non-RCRA, state-regulated hazardous waste. A discussion of waste characterization is included in Section A1.4.

A1.4 Waste Characterization

Selection of ARARs involves the characterization of wastes as described below.

A1.4.1 RCRA Hazardous Waste Determination

Federal RCRA hazardous waste determination is necessary to determine whether a waste is subject to RCRA requirements at 22 CCR div. 4.5, and other state requirements at 23 CCR div. 3, ch. 15. The first step in the RCRA hazardous waste characterization process is to evaluate contaminated media at the site(s) and determine whether the contaminant constitutes a "listed" RCRA waste. The preamble to the NCP states that "... it is often necessary to know the origin of the waste to determine whether it is a listed waste and that, if such documentation is lacking, the lead agency may assume it is not a listed waste" (55 Federal Register 8666, 8758 [1990]).

This approach is confirmed in U.S. EPA guidance for CERCLA compliance with other laws (U.S. EPA, 1988), as follows:

> "To determine whether a waste is a listed waste under RCRA, it is often necessary to know the source. However, at many Superfund sites, no information exists on the source of wastes. The lead agency should use available site information, manifests, storage records, and vouchers in an effort to ascertain the nature of these contaminants. When this documentation is not available, the lead agency may assume that the wastes are not listed RCRA hazardous wastes, unless further analysis or information becomes available that allows the lead agency to determine that the wastes are listed RCRA hazardous wastes."

RCRA hazardous wastes that have been assigned U.S. EPA hazardous waste numbers (or codes) are listed in 22 CCR §66261.30–66261.33. The lists include hazardous waste codes beginning with the letters "F," "K," "P," and "U."

Knowledge of the exact source of a waste is required for source-specific listed wastes ("K" waste codes). Some knowledge of the nature or source of the waste is required even for listed wastes from nonspecific sources, such as spent solvents ("F" waste codes) or commercial chemical products ("P" and "U" waste codes). These listed RCRA hazardous wastes are restricted to commercially pure chemicals used in particular processes such as degreasing.

P and U wastes cover only unused and unmixed commercial chemical products, particularly spilled or off-spec products (U.S. EPA, 1991a). Not every waste containing a P or U chemical is a hazardous waste. To determine whether a CERCLA investigation-derived waste contains a P or U waste, there must be direct evidence of product use. In particular, all the following criteria must be met. The chemicals must be:

- Discarded (as described in 40 CFR §261.2[a][2]),
- Either off-spec commercial products or a commercially sold grade,
- Not used (soil contaminated with spilled unused wastes is a P or U waste), and
- The sole active ingredient in a formulation.

Available historical information was reviewed during the RCRA Facility Assessment (RFA) and the Remedial Investigation (RI). Interviews were conducted with past and current MCB Camp Pendleton staff. No documentation of past waste disposal practices was found that would serve to classify the source of soil contamination at Site 1111 with respect to the RCRA waste listings. Therefore, the DON has made the determination that Site 1111 soil does not contain potential RCRA-listed hazardous waste. By extension, excavated soil also would not be RCRA-listed hazardous wastes.

The second step in the RCRA hazardous waste characterization process is to evaluate potential hazardous characteristics of the waste. The evaluation of characteristic waste is described in U.S. EPA (1988) guidance:

> "Under certain circumstances, although no historical information exists about the waste, it may be possible to identify the waste as RCRA characteristic waste. This is important in the event that (1) remedial alternatives under consideration at the site involve on-site treatment, storage, or disposal, in which case RCRA may be triggered as discussed in this section; or (2) a remedial alternative involves off-site shipment. Because the generator (in this case, the agency or responsible party conducting the Superfund action) is responsible for determining whether the wastes exhibit any of these characteristics (defined in 40 CFR §261.21-261.24), testing may be required. The lead agency must use best professional judgment to determine, on a site-specific basis, if testing for hazardous characteristics is necessary.
>
> "In determining whether to test for the toxicity characteristic using the extraction procedures (EP) toxicity test, it may be possible to assume that certain low concentrations of waste are not toxic. For example, if the total waste concentration in soil is 20 times or less the EP toxicity concentration, the waste cannot be characteristic hazardous waste. In such a case, RCRA requirements would not be applicable. In other instances, where it appears that the substances may be characteristic hazardous waste (ignitable, corrosive, reactive, or EP toxic), testing should be performed."

Hazardous waste characteristics, as defined in 40 CFR §261.21-261.24, are commonly referred to as ignitability, corrosivity, reactivity, and toxicity. California environmental health standards for the management of hazardous waste set forth in 22 CCR div. 4.5 were approved by U.S. EPA as a component of the federally authorized California RCRA program. Therefore, the characterization of RCRA waste is based on the state requirements.

The characteristics of ignitability, corrosivity, reactivity, and toxicity are defined in 22 CCR §66261.21-66261.24. According to 22 CCR §66261.24(a)(1)(A), "A waste that exhibits the characteristic of toxicity pursuant to subsection (a)(1) of this section has the EPA Hazardous Waste Number specified in Table I of this section which corresponds to the toxic contaminant causing it to be hazardous." Table I assigns hazardous waste codes beginning with the letter "D" to wastes that exhibit the characteristic of toxicity; D waste codes are limited to "characteristic" hazardous wastes.

According to 22 CCR §66261.10, waste characteristics can be measured by an available standardized test method or be reasonably classified by generators of waste based on their knowledge of the waste provided that the waste has already been reliably tested or if there is documentation of chemicals used.

Soil at Site 1111 is not ignitable, corrosive, or reactive, as defined in 22 CCR §66261.21-66261.23. This determination was based on knowledge of the nature and concentrations of contaminants.

The requirements at 22 CCR §66261.24 list the toxic contaminant concentrations that determine the characteristic of toxicity. The concentration limits are in milligrams per liter (mg/L). For waste soils, these concentrations apply to the extract or leachate produced by the Toxicity Characteristic Leaching Procedure (TCLP).

A waste is considered hazardous if the contaminants in the soil TCLP extract equals or exceeds the TCLP limits. TCLP testing is required only if total contaminant concentrations in soil equal or exceed 20 times the TCLP limits because TCLP uses a 20-to-1 dilution for the extract (U.S. EPA, 1988).

Soil sampling results at Site 1111 have indicated concentrations of metals that exceed RCRA characteristic hazardous waste levels. If the soil were excavated, the waste soil would potentially be a RCRA characteristic hazardous waste.

A1.4.2 California-Regulated, Non-RCRA Hazardous Waste

A waste determined not to be a RCRA hazardous waste may still be considered a state-regulated non-RCRA hazardous waste. The state is broader in scope in its RCRA program in determining hazardous waste. 22 CCR §66261.24(a)(2) lists the total threshold limit concentrations (TTLCs) and the soluble threshold limit concentrations (STLCs) for non-RCRA hazardous waste. The state applies its own leaching procedure, the California Waste Extraction Test (WET), which uses a different acid reagent and has a different dilution factor (tenfold). Other state requirements may be broader in scope than federal ARARs for identifying non-RCRA wastes regulated by the state. These may be potential ARARs for wastes not covered under federal ARARs (see additional subsections of 22 CCR §66261.24). A waste is considered hazardous if its total concentrations exceed the TTLCs or if the extract concentrations from the WET exceed the STLCs. A WET is required when the total concentrations exceed the STLC but are less than the TTLCs (22 CCR div. 4.5, ch. 11, Appendix [app.] II [b]).

The soil sampling results at Site 1111 indicated that concentrations in soil exceed TTLC limits and 10 times the STLC limits for metals. Therefore, if waste soil is generated at Site 1111, it may be a non-RCRA California hazardous waste.

A2 CHEMICAL-SPECIFIC ARARS

This section presents ARARs conclusions addressing numerical values for soil and air at Site 1111. Following the conclusions, there is a more detailed discussion of the identified ARARs. Federal and state chemical-specific ARARs are summarized in Tables A2-1 and A2-2, respectively.

Chemical-specific ARARs are generally health- or risk-based numerical values or methodologies applied to site-specific conditions that result in the establishment of a cleanup level. Many potential ARARs associated with particular response alternatives (such as closure or discharge) can be characterized as action-specific but include numerical values or methodologies to establish them so they fit in both chemical- and action-specific categories. To simplify the comparison of numerical values, most action-specific requirements that include numerical values are included in this chemical-specific section and, if repeated in the action-specific section, the discussion refers back to this section.

A2.1 Summary of ARARs Conclusions by Medium

Soil and air are the environmental media potentially affected by the Site 1111 removal action. The conclusions for ARARs pertaining to these media are presented in the following sections.

A2.1.1 Soil ARARs

Soil ARARs were evaluated for Site 1111. The RCRA requirements at 22 CCR §66261.21, 66261.22(a)(1), 66261.23, 66261.24(a)(1), and 66261.100 are ARARs because they define RCRA hazardous waste. Based on sampling results, the concentrations of metals in the soil indicate that excavated soil could exceed characteristic hazardous waste levels.

The requirements at 22 CCR §66264.94(a)(1), (a)(3), (c), (d), and (e) are federal ARARs for the vadose zone (i.e., the unsaturated zone contamination). These sections set concentration limits for the unsaturated zone, and are considered to be potential federal ARARs because they are part of the approved state RCRA program. The contaminated soil being addressed by the removal action at Site 1111 could generate hazardous waste. Therefore, these requirements are potentially applicable for cleanup of waste generated during the removal action, such as waste generated during excavation. It has been determined that cleanup to background levels is not technologically and economically feasible. The lowest achievable levels that are technologically and economically feasible are risk-based levels that assure protection of human health and the environment, including groundwater. However, the remedial alternatives could result in levels lower than risk-based levels and could result in meeting background levels over time. It has been determined that additional work to meet levels lower than risk-based levels is not economically feasible because risk levels will already be acceptable.

A2.1.2 Air ARARs

The soil excavation or moving activities proposed for Site 1111 have the potential to generate dust particle emissions. Several San Diego Air Pollution Control District (APCD) requirements have been determined to be chemical-specific federal ARARs for dust control, and have been approved into the State Implementation Plan (SIP). APCD Rule 50(d)(1) addresses discharge of any air contaminant and is considered a applicable federal ARAR for the discharge of particulate matter via fugitive dust emissions from soil excavation. Rule 50(d)(1) prohibits discharge of any air contaminant from any single source of emissions that is darker than number 1 on the Ringlemann Chart for more than 3 minutes in any 60-minute period.

A2.2 Detailed Discussion of ARARs by Medium

The following subsections provide a detailed discussion of federal and state ARARs by medium.

A2.2.1 Soil ARARs

Soil ARARs were evaluated for Site 1111. The key threshold question for soil ARARs was whether the soil located at Site 1111 would be classified as hazardous waste if excavated. RI data indicate that contaminants are present in soil at concentrations that exceed the hazardous waste levels for RCRA and non-RCRA hazardous waste. Therefore, if the soil is excavated, at least a portion would likely be hazardous waste.

A2.2.1.1 Federal

RCRA Hazardous Waste and Groundwater Protection Standards

The federal RCRA requirements at 40 CFR §261 do not apply in the State of California because the state RCRA program is authorized. The authorized state RCRA requirements are therefore considered potential federal ARARs (see Section A1.3). The applicability of RCRA requirements depends on whether the waste is a RCRA hazardous waste; whether the waste was initially treated, stored, or disposed after the effective date of the particular RCRA requirement; and whether the activity at the site constitutes treatment, storage, or disposal as defined by RCRA. However, RCRA requirements may be relevant and appropriate even if they are not applicable. Examples include activities that are similar to the definition of RCRA treatment, storage, or disposal for waste that is similar to RCRA hazardous waste.

The determination of whether a waste is a RCRA hazardous waste can be made by comparing the site waste to the definition of RCRA hazardous waste. The RCRA requirements at 22 CCR §66261.21, 66261.22(a)(1), 66261.23, 66261.24(a)(1), and 66261.100 are ARARs because they define RCRA hazardous waste. A waste can meet the definition of hazardous waste if it has the toxicity characteristic of hazardous waste. This determination is made by using the Toxicity Characteristic Leaching Procedure (TCLP). The maximum concentrations allowable for the TCLP listed in 22 CCR §66261.24(a)(1)(B) are federal ARARs for determining whether the site has hazardous waste. If the site soil has concentrations exceeding these values, it would be determined to be a characteristic RCRA hazardous waste if excavated (see Section A1.4.1). Based on sampling results, the concentrations of metals in the soil at Site 1111 indicate that excavated soil could exceed characteristic hazardous waste levels.

The requirements at 22 CCR §66264.94(a)(1), (a)(3), (c), (d), and (e) are federal ARARs for the vadose zone (i.e., the unsaturated zone contamination). These sections set concentration limits for the unsaturated zone, and are considered to be potential federal ARARs because they are part of the approved state RCRA program. The contaminated soil being addressed by the removal action at Site 1111 could generate hazardous waste. Therefore, these requirements are potentially applicable for cleanup of waste generated during the removal action, such as waste generated during excavation. It has been determined that cleanup to background levels is not technologically and economically feasible. The lowest achievable levels that are technologically and economically feasible are risk-based levels that assure protection of human health and the environment, including groundwater. However, the remedial alternatives could result in levels lower than risk-based levels and could result in meeting background levels over time. It has been determined that additional work to meet levels lower than risk-based levels is not economically feasible because risk levels will already be acceptable.

A2.2.1.2 State

RCRA Requirements

State RCRA requirements included within the U.S. EPA-authorized RCRA program for California are considered to be potential federal ARARs and are discussed above. When state regulations are either broader in scope or more stringent than their federal counterparts, they are considered potential state ARARs. State requirements such as the non-RCRA, state-regulated hazardous waste requirements may be potential state ARARs because they are not within the scope of the federal ARARs (57 Federal Register 60848). The 22 CCR div. 4.5 requirements that are part of the state-approved RCRA program would be potential state ARARs for non-RCRA, state-regulated hazardous wastes.

The site waste characteristics need to be compared to the definition of non-RCRA, state-regulated hazardous waste. The non-RCRA, state-regulated waste definition requirements at 22 CCR §66261.24(a)(2) are state ARARs for determining whether other RCRA requirements are state ARARs, and list TTLCs and STLCs. The site waste may be compared to these thresholds to determine whether it meets the characteristics for a non-RCRA, state-regulated hazardous waste.

As discussed in Section A1.4.1, the soil sampling results at Site 1111 indicated that concentrations in soil exceed TTLC limits and 10 times the STLC limits for metals. Therefore, the waste may be a non-RCRA California hazardous waste.

State Water Resources Control Board Res. 92-49

State Water Resources Control Board Res. 92-49 (as Amended on April 21, 1994 and October 2, 1996) is titled Policies and Procedures for Investigation and Cleanup and Abatement of Discharges Under California Water Code §13304. This resolution contains policies and procedures for the regional boards that apply to all investigations and cleanup and abatement activities for all types of discharges subject to California Water Code §13304.

Cleanup to below background water quality conditions is not required by the SWRCB under the Porter-Cologne Act. SWRCB Res. 92-49 II.F.1 (SWRCB, 1992) provides that regional boards may require cleanup and abatement to "conform to the provisions of the Resolution No. 68-16 of the State Water Board, and the Water Quality Control Plans of the State and Regional Water Quality Control Boards, provided that under no circumstances shall these provisions be interpreted to require cleanup and abatement that achieves water quality conditions that are better than background conditions."

DON's Position Regarding SWRCB Res. 92-49

The DON recognizes that the key substantive requirements of 22 CCR §66264.94 (and the identical requirements of CCR Title 23, §2550.4 and Section III.G of SWRCB Res. 92-49) require cleanup to background levels of constituents unless such restoration proves to be technologically or economically infeasible and an alternative cleanup level of constituents will not pose a substantial present or potential hazard to human health or the environment. In addition, the DON recognizes that these provisions are more stringent than corresponding provisions of 40 CFR §264.94 and, although they are federally enforceable via the RCRA program authorization, they also are based independently on state law to the extent that they are more stringent than the federal regulations.

The DON's position is that SWRCB Res. 92-49 and 23 CCR §2550.4 do not constitute chemical-specific ARARs for this removal action because they are state requirements and are not more stringent than federal ARAR provisions of 22 CCR §66264.94. The NCP set forth in 40 CFR §300.400(g)(4) provides that only state standards more stringent than federal standards may be ARARs (see also CERCLA Section 121(d)(2)(A)(ii) [42 USC §9621(d)(2)(A)(ii)]).

The substantive technical standard in the equivalent state requirements (i.e., CCR Title 23, div. 3, ch. 15 and SWRCB Res. 92-49) is identical to the substantive technical standard in 22 CCR §66264.94. This section of CCR Title 22 will likely be applied in a manner consistent with equivalent provisions of other regulations, including SWRCB Res. 92-49.

State of California's Position Regarding SWRCB Res. 92-49 and 68-16

The state does not agree with the DON determination that SWRCB Res. 92-49 and certain provisions CCR Title 23, div. 3, ch. 15 are not ARARs for this removal action. SWRCB has interpreted the term "discharges" in the California Water Code to include the movement of waste from soils to groundwater and from contaminated to uncontaminated water (SWRCB, 1994). However, the state agrees that the proposed action would comply with SWRCB Res. 92-49, and that compliance with CCR Title 22 provisions should result in compliance with CCR Title 23 provisions. The state does not intend to dispute the Action Memorandum but reserves its rights if implementation of the CCR Title 22 provisions is not as stringent as state implementation of CCR Title 23 provisions. Because CCR Title 22 regulation is part of the state's authorized hazardous waste control program, it also is the state's position that 22 CCR §66264.94 is a state ARAR and not a federal ARAR (United States v. State of Colorado, 990 F.2d 1565 [1993]).

Whereas the DON and the State of California have not agreed on whether SWRCB Res. 92-49 and CCR Title 23, §2550.4 are ARARs for this removal action, this Action Memorandum documents each of the parties' positions on the resolutions but does not attempt to resolve the issue.

A2.2.2 Air ARARs

There are potential emissions to air for the soil movement activities proposed for Site 1111.

A2.2.2.1 Federal

The CAA and RCRA air emission requirements are discussed below.

Clean Air Act

The CAA establishes the National Ambient Air Quality Standards (NAAQS) in 40 CFR §50.4-50.12. NAAQS are not enforceable in and of themselves; they are translated into source-specific emissions limitations by the state (U.S. EPA, 1990). Substantive requirements of the San Diego APCD rules that have been approved by U.S. EPA as part of the SIP under the CAA are potential federal ARARs for air emissions (CAA §110).

The SIP includes rules for emissions restrictions for particulates under San Diego APCD. APCD Rule 50(d)(1) addresses discharge of any air contaminant and is considered an applicable federal ARAR for the discharge of particulate matter via fugitive dust emissions from soil excavation. Rule 50(d)(1) prohibits discharge of any air contaminant from any single source of emissions that is darker than number 1 on the Ringlemann Chart for more than 3 minutes in any 60-minute period.

A2.2.2.2 State

No state ARARs were identified for air emissions for the proposed Site 1111 removal action.

A3 LOCATION-SPECIFIC ARARS

Location-specific ARARs are identified and discussed in this section. The discussions are presented based on various attributes of the site location, such as whether it is within a floodplain. Additional surveys will be performed in connection with the response action design and execution to confirm location-specific ARARs where inadequate siting information currently exists, or in the event of changes to planned facility locations.

The proximity of Site 1111 to the Santa Margarita River is ecologically significant because the area supports diverse wildlife and plant species. Approximately 10 to 20 mammal species and 80 resident and migratory bird species may regularly use the site vicinity. About 8 to 10 species of amphibian and reptiles probably occur in the site vicinity, including the Western Toad and Common King Snake. The adjacent riparian habitats of the Santa Margarita River support numerous endangered and threatened wildlife species, including the Arroyo Southwestern Toad, Pacific Pocket Mouse, Southwestern Pond Turtle, Least Bell's Vireo, and Southwestern Willow Flycatcher (SWDIV, 1993).

The undisturbed/unremediated portion of Site 1111 is considered arroyo southwestern toad habitat, and therefore is a sensitive ecological habitat. Least Bell's vireos and southwestern willow flycatchers are also known to nest at Site 1111. Vegetation has been removed in the disturbed/remediated portion of Site 1111.

A3.1 Summary of Location-Specific ARARs Conclusions

Floodplain management, cultural resources, and biological resources are the resource categories relating to location-specific requirements potentially affected by the Site 1111 removal action. The conclusions for ARARs pertaining to these resources are presented in the following sections.

A3.1.1 Cultural Resources ARARs

There are no potential historical buildings or landmarks at Site 1111. There are no known archaeological resources at Site 1111. However, because there is undisturbed land that may be excavated at Site 1111, substantive provisions of the Archaeological Resources Protection Act of 1979, set forth in 32 CFR 229.4 and 229.13(a), for the protection of archaeological resources on federal lands, are applicable federal ARARs for excavation activities at Site 1111. No person may excavate, remove, damage, or otherwise alter or deface, or attempt to excavate, remove, damage, or otherwise alter or deface any archaeological resource located on public lands unless such activity is in accordance with a permit. The archaeological resources which are excavated or removed from public lands will remain the property of the United States, and such resources and copies of associated archaeological records and data will be preserved by a suitable university, museum, or other scientific or educational institution. The substantive provisions of this requirement may be applicable if there is a potential for archaeological resources to be affected by excavation proposed at Site 1111.

In addition, substantive provisions of 16 USC §469 are applicable for site 1111 excavation. Construction on previously undisturbed land would require an archaeological survey of the area. Data recovery and preservation would be required if significant archaeological or historical data were found on-site. The responsible official or Secretary of the Interior is authorized to undertake data recovery and preservation. The substantive provisions of these requirements are applicable if there is the potential for excavation at Site 1111 to affect archaeological resources.

A3.1.2 Floodplain Management

Site 1111 is within an area susceptible to flooding during a statistical 100-year flood event. The regulations at 22 CCR 66264.18(b) require that a hazardous waste facility within a 100-year floodplain be designed, constructed, operated, and maintained to avoid washout. This requirement is pertinent to Site 1111 actions that may store hazardous waste. Therefore, the substantive provisions of this requirement are applicable for soil actions at Site 1111 that could store hazardous waste.

Under 40 CFR §6.302(b), federal agencies are required to evaluate the potential effects of action they may take in a floodplain to avoid, to the extent possible, adverse effects associated with direct and indirect development of a floodplain. The substantive provisions of this requirement are applicable for the Site 1111 soil removal action.

A3.1.3 Biological Resources

The southwest willow flycatcher, the least Bell's vireo and the arroyo southwestern toad are federally endangered species that are known to exist in the type of habitat present on Site 1111. The substantive provisions of the Endangered Species Act (ESA) at 16 USC §1536(a), (h)(1)(B) are applicable for the actions proposed at Site 1111 for the habitat and species if observed on-site.

Migratory birds have been observed in the vicinity of Site 1111. The substantive provisions of 16 USC 703 protects almost all species of native birds in the United States from unregulated take. This requirement is relevant and appropriate for the proposed excavation activities at Site 1111.

Substantive provisions of the following state requirements were identified as ARARs: Fish and Game Code §5650(a) and (f) prohibiting passage of deleterious substances to waters; Cal. Fish and Game Code Sections §3005(a) for birds and mammals, §3503 for any bird, §3503.5 for the White-tailed Kite, §3800(a) for non-game birds, §4002 for fur-bearing mammals, and §4150 for non-game mammals.

A3.1.4 Coastal Resources

Site 1111 is not close enough to the coast to be within the coastal zone.

A3.1.5 Geologic Characteristics

Site 1111 does not have any known geological characteristics that are regulated.

A3.2 Detailed Discussion of ARARs

The following subsections provide a detailed discussion of federal and state location-specific ARARs. Requirements that are determined to be ARARs are identified in Table A3-1 (federal) and Table A3-2 (state). Determinations of status for location-specific ARARs were based on consultation of maps or lists included in the regulation or prepared by the administering agency. References to the document or agency consulted are provided in the Comments column and may be provided in footnotes to the table. Specific issues concerning some of the requirements are discussed in the following sections.

A3.2.1 Wetlands Protection and Floodplains Management ARARs

Site 1111 is within a floodplain. The substantive provisions of the following requirements were identified as ARARs for the removal action at Site 1111:

- Floodplain Management (40 CFR §6.302[b]);
- RCRA 22 CCR §66264.18(b).

A3.2.1.1 Federal

Floodplain Management, Executive Order No. 11988

Under 40 CFR §6.302(b), federal agencies are required to evaluate the potential effects of action they may take in a floodplain to avoid, to the extent possible, adverse effects associated with direct and indirect development of a floodplain.

Site 1111 is within a floodplain. Therefore, substantive provisions of 40 CFR §6.302(b) are applicable for the removal action at Site 1111.

Resource Conservation and Recovery Act (42 USC §6901–6991[i])

Under 22 CCR §66264.18(b), any hazardous waste facility located in a 100-year floodplain or within the maximum high tide must be designed, constructed, operated, and maintained to prevent washout of any hazardous waste by a 100-year flood or maximum high tide, unless the owner or operator can demonstrate that procedures are in effect that will cause the waste to be removed safely, before flood or tidewater can reach the facility.

Site 1111 is located within a floodplain. Therefore, substantive provisions of 22 CCR §66264.18(b) floodplain requirements are applicable if hazardous waste is generated and stored during the removal action.

A3.2.1.2 State

The state RCRA requirements for floodplains are evaluated above as potential federal ARARs.

A3.2.2 Biological Resources ARARs

Although Site 1111 contains habitat for endangered or threatened species, no endangered or threatened species have been observed at Site 1111. Migratory birds have been observed in the vicinity of Site 1111. The following requirements were identified as ARARs:

- Endangered Species Act of 1973 (substantive provisions of 16 USC §1536(a), (h)(1)(B) are applicable for habitat and species if observed on-site);
- Migratory Bird Treaty Act of 1972 (substantive provisions of 16 USC §703 are relevant and appropriate).

A3.2.2.1 Federal

Endangered Species Act of 1973

The ESA of 1973 (16 USC §1531-1543) provides a means for conserving various species of fish, wildlife, and plants that are threatened with extinction. The ESA defines an endangered species and provides for the designation of critical habitats. Federal agencies may not jeopardize the continued existence of any listed species or cause the destruction or adverse modification of critical habitat. Under Section 7(a) of the ESA, federal agencies must carry out conservation programs for listed species. The Endangered Species Committee may grant an exemption for agency action if reasonable mitigation and enhancement measures such as propagation, transplantation, and habitat acquisition and improvement are implemented. Consultation regulations at 50 CFR §402 are administrative in nature and are therefore not ARARs.

The southwest willow flycatcher, the least Bell's vireo, and the arroyo southwestern toad are federally listed endangered species that use habitat present on Site 1111. The substantive provisions of the ESA at 16 USC §1536(a), (h)(1)(B) are applicable for the removal action at Site 1111 for the habitat and species if observed on-site.

Migratory Bird Treaty Act of 1972

The Migratory Bird Treaty Act (16 USC §703-712) prohibits at any time, using any means or manner, the pursuit, hunting, capturing, and killing or attempting to take, capture, or kill any migratory bird. This act also prohibits the possession, sale, export, and import of any migratory bird or any part of a migratory bird, as well as nests and eggs. A list of migratory birds for which this requirement applies is found at 50 CFR §10.13. It is the DON's position that this act is not legally applicable to DON actions; however, EO No. 13186 (dated January 10, 2001) requires each federal agency taking actions that have or are likely to have a measurable effect on migratory bird populations to develop and implement, within two years, a memorandum of understanding (MOU) with the United States Fish and Wildlife Service (USFWS) to promote the conservation of such populations. The DoD and the USFWS are in the process of negotiating this MOU. In the meantime, the Migratory Bird Treaty Act will continue to be evaluated as a potentially relevant and appropriate requirement for DON CERCLA response actions.

Migratory birds have been observed in the vicinity of Site 1111. Therefore, the substantive provisions of 16 USC §703 are relevant and appropriate for the removal action at Site 1111 that could result in a take.

A3.2.2.2 State

California Endangered Species Act

The California Endangered Species Act is codified in the California Fish and Game Code (CFGC) §2050-2116. It is the DON's position that the requisite federal sovereign immunity waiver does not exist to authorize applicability of the California Endangered Species Act. Nevertheless, this act was evaluated as a potentially relevant and appropriate requirement for the removal action at Site 1111. CFGC §2080 prohibits the take of endangered species.

Site 1111 may also provide habitat for state-listed endangered or threatened species that are not federally listed. For these species, the substantive provisions of the state requirements would be potential ARARs. However, the substantive provisions of CFGC §2080 are not more stringent than already identified federal ARARs. Therefore, CFGC §2080 is not an ARAR for this removal action.

Other California Fish and Game Requirements

California Fish and Game Code §5650(a) and (f) prohibits the passage of enumerated substances or materials into waters of the state deleterious to fish, plant life, or birds. This has been determined to be an ARAR for excavation at Site 1111 where materials may be placed where they could enter surface water.

Other California Department of Fish and Game requirements also were identified as relevant and appropriate requirements. These requirements are not potential ARARs for overlapping federal ARARs. The state requirements are not more stringent for the federally protected species. However, the state requirements may be broader in scope than the federal ARARs and may address additional species. For these non-federally protected species, the following are relevant and appropriate requirements during proposed remedial actions: Cal. Fish and Game Code Sections §3005(a) for birds and mammals, §3503 for any bird, §3503.5 for the White-Tailed Kite, §3800(a) for non-game birds, §4002 for fur-bearing mammals, and §4150 for non-game mammals.

A4 ACTION-SPECIFIC ARARs

This section identifies action-specific ARARs identified for the removal action alternatives for Site 1111 soil at MCB Camp Pendleton. The removal action alternatives include:

S1 – No further action
S2 – Institutional controls
S3 – Excavation, off-base disposal, and backfill.

Detailed descriptions of the removal action alternatives are provided in the main text of this Action Memorandum.

Tables A4-1 and A4-2 present and evaluate federal and state action-specific ARARs for Site 1111, respectively. A discussion of the requirements determined to be pertinent to the removal action is presented in this section. A discussion of how the removal action alternatives comply with each identified ARAR also is provided.

A4.1 No Further Action

There is no need to identify ARARs for the no further action alternative because ARARs apply to "any removal or remedial action conducted entirely on site," and "no action" is not a removal or remedial action (CERCLA Section 121(e), 42 USC §9621[e]). CERCLA Section 121 (42 USC §9621) cleanup standards for selection of a Superfund remedy, including the requirement to meet ARARs, are not triggered by the no further action alternative (U.S. EPA, 1991b). Therefore, a discussion of compliance with action-specific ARARs is not appropriate for this alternative.

A4.2 Institutional Controls

There are no federal ARARs for land-use controls; however, U.S. EPA and the Navy have developed guidance pertaining to land-use controls. The California Military Environmental Coordination Committee (CMECC) has developed the Institutional Control Protocol at Open Bases for application at active military installations. This protocol is a consensus document that is intended to aid federal and state remedial project managers when incorporating institutional controls into CERCLA response actions. The committee is made up of Cal-EPA, U.S. EPA, and the DON. The DON has agreed that the institutional control protocol for active bases should be followed for sites that require institutional controls as part of their CERCLA response action. Therefore, the Institutional Control Protocol at Open Bases may be guidance for sites that require institutional controls.

The Institutional Control Protocol at Open Bases states that the Base Master Plan (BMP) is typically the best place to record the institutional controls in order to assure their implementation by the DoD installation. The BMP establishes land uses for the DoD installation and requirements similar to zoning. The BMP is used by the installation for evaluating land-use decisions and for project planning. Depending on the installation project planning and project approval process, other documents or more than one document may be required to include the institutional controls to assure adherence to the institutional controls.

A4.3 Excavation, Off-Base Disposal, and Backfill

Because the soil at Site 1111 is potentially a hazardous waste based on sampling results for metal concentrations, RCRA requirements were evaluated as potential ARARs.

A.4.3.1 Excavation/Temporary Storage of Waste/Off-Base Disposal

Because the soil at Site 1111, when excavated, may be a hazardous waste based on sampling results for metal concentrations, RCRA requirements were evaluated as potential ARARs. Soil would be subject to RCRA requirements at 22 CCR §66262.10(a), §66262.11, and §66264.13(a) and (b) to determine whether such wastes should be classified as hazardous. Based on RI sampling results, the soil is expected to meet characteristic RCRA hazardous waste levels. Therefore, the waste accumulation and container storage requirements at 22 CCR §66262.34 and 66264.171-175, 177 and 178 are applicable ARARs for the soil at Site 1111.

A.4.3.2 Staging Piles (40 CFR §264.554)

Although the State of California has not promulgated its own regulation for staging piles, it has obtained interim authorization by rule under 40 CFR §271.27(a)(2). In a letter dated March 18, 2002, Cal-EPA DTSC notified U.S. EPA that California intended to adopt the January 22, 2002 amended corrective action management unit (CAMU) rule. California was authorized under RCRA for the 16 February 1993 CAMU rule as required under 40 CFR §271.27(a)(1) to gain interim authorization for the 2002 amended rule. Therefore, the amended federal regulations at 40 CFR §264.554 are state regulations. However, because they are federally enforceable as are the other authorized state RCRA requirements (see Section A1.3.1), they are federal ARARs.

Regulations at 40 CFR §264.554 allow relief from land disposal restrictions (LDRs) for temporary storage (less than 2 years) of remediation waste on contiguous property. Placing hazardous remediation wastes in a staging pile does not trigger LDRs or minimum technology requirements (MTRs). In addition, physical operations such as mixing, sizing, blending, etc. that are intended to prepare wastes for subsequent management or treatment are allowed to occur in staging piles regardless of whether they technically meet the RCRA definition of "treatment." The substantive provisions of §264.554(d)(1)(i-ii), (d)(2),(h),(i),(j), and (k) are ARARs for design, operating, and closure criteria for the staging pile.

The staging pile regulations also require that the unit facilitate a remedy that is reliable, effective, and protective (§264.554[d][1][i]); and be designed using appropriate measures (e.g., liners, covers, run-on/runoff controls, groundwater monitoring system) to prevent or minimize releases and cross-media transfers of hazardous wastes and constituents (§264.554[d][1][ii]). For units located in a previously contaminated area of the facility, all remediation wastes, contaminated containment system components, structures, and equipment that are contaminated with waste or leachate must be removed or decontaminated within 180 days after the operating term of the staging pile expires (§264.554[j]). In addition, contaminated subsoils must be decontaminated. For units located on uncontaminated areas of the facility, within 180 days following expiration of the operating term, the staging pile must be closed in accordance with waste pile closure requirements at 22 CCR §66264.258(a) and the closure performance standards at 22 CCR §66264.111 for permitted (§264.554[k]).

A.4.3.3 Temporary Units (22 CCR §66264.553)

Alternative requirements that are protective of human health or the environment may replace design, operating, or closure standards for temporary container storage areas used for storage of hazardous remediation wastes during the removal action. These units are not subject to RCRA LDRs. The substantive requirements at 22 CCR §66264.553(b), (d),(e), and (f) are ARARs for a temporary unit. For example, these requirements may relax the requirements for secondary containment for container storage (22 CCR §66264.171-178), based on the considerations for protecting human health and the environment.

A.4.3.4Construction Activities/Stormwater Pollution Prevention Requirements

On November 16, 1990, U.S. EPA final regulations implementing Section 402(p) of the CWA setting forth the requirements for the Phase I Stormwater NPDES permit requirements were promulgated (55 Federal Register 47990). U.S. EPA's Phase I Stormwater NPDES regulations require that owner/operators of construction activities obtain permit coverage and be in compliance with discharge standards. The Phase II Stormwater Rule was promulgated on December 8, 1999. On March 10, 2003, the new Phase II regulations came into effect. The Phase II requirements effectively lowered the size limit on construction activities covered by the requirements from those disturbing 5 acres or more (Phase I) to 1 acre or more (Phase II). U.S. EPA is looking to states with delegated NPDES programs such as California to take the lead in issuing permits that implement the new regulations.

Section 121(e) of CERCLA exempts on-site CERCLA response actions from permit requirements. CERCLA on-site response actions must comply with federal and state ARARs, the promulgated substantive requirements of the federal and state laws and regulations that are typically implemented via environmental permit processes. The DON follows the CERCLA process instead of these permitting processes when making CERCLA decisions.

Substantive provisions of U.S. EPA's stormwater NPDES regulations for construction activities as well as the CWA provisions that they implement are potential applicable federal ARARs for IR sites that involve construction after the effective date of the regulations.

CWA statutory effluent treatment requirements for stormwater discharges from small construction activity are potential federal ARARs. They are specified in Section 402(p)(3)(A) of the CWA (42 USC §1342[p][3][A]) to include all standards set forth in Section 402 of the CWA. As for most other discharge categories, those standards are the long-standing best available technology economically achievable (BAT) requirement for toxic pollutants and best conventional pollutant control technology (BCPCT) requirement for conventional pollutants, as well as state water quality standards.

The substantive part of U.S. EPA's CWA/NPDES stormwater program is the requirement to develop and implement best management practices (BMPs) to manage stormwater discharges. Although BMPs have been designated by U.S. EPA as a form of "effluent limitation," they are prescribed management practices rather than more traditional "end-of-pipe" numeric effluent limitations. A stormwater plan is a required procedural mechanism for developing BMPs and obtaining regulatory approval of BMPs in the CWA context. The substantive provisions of the general requirements for stormwater plans and BMPs set forth in 40 CFR §122.44(k)(2) and (4) are federal ARARs for construction activities where 1 acre or more of soil will be disturbed.

A5 REFERENCES

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U.S. EPA, see United States Environmental Protection Agency.

TABLES

Table A2-1. Federal Chemical-Specific[a] ARARs

Requirement	Prerequisite	Citation[b]	ARAR Determination	Comments
Resource Conservation and Recovery Act (42 USC, ch. 82, §6901–6991[I]) [c]				
Defines RCRA hazardous waste. A solid waste is characterized as toxic, based on the TCLP, if waste exceeds TCLP maximum concentrations.	Waste.	CCR tit. 22, §66261.21, 66261.22(a)(1), 66261.23, 66261.24(a)(1), and 66261.100	Applicable	Substantive provisions are applicable for determining whether waste soil, if generated, is hazardous.
Groundwater Protection Standards: requirements to ensure that hazardous constituents entering the groundwater from a regulated unit do not exceed the concentration limits for contaminants of concern in the uppermost aquifer underlying the waste management area of concern at the POC.	A regulated unit that receives or has received hazardous waste before 26 July 1982 or ceased receiving hazardous waste prior to 26 July 1982 where constituents in or derived from the waste may pose a threat to human health or the environment.	CCR tit. 22, §66264.94(a)(1) and (3), (c), (d), and (e)	Relevant and appropriate	Substantive provisions are relevant and appropriate for setting soil cleanup levels. Cleanup to background has been determined to be NOT technologically and economically feasible. The lowest achievable concentrations are risk-based.
Clean Air Act (42 USC, ch. 85, §7401–7671) [c]				
Provisions of SIP approved by U.S. EPA under Section 110 of CAA.	Major sources of air pollutants.	42 USC §7401; portions of 40 CFR §52.220 applicable to San Diego APCD	Applicable.	Substantive provisions are applicable. See pertinent specific provisions of the SIP below.
No person shall discharge into the atmosphere from any single source of emissions, for more than 3 minutes in any 60-minute period, any air contaminant that is darker than number 1 on the Ringlemann chart.	Discharge of any air contaminant other than uncombined water vapor.	APCD Rule 50(d)(1)	Applicable	Substantive provisions are applicable to emissions that may be caused by soil movement and storage.

Notes:
(a) Many potential action-specific ARARs contain chemical-specific limitations and are addressed in the action-specific ARAR tables.
(b) Only the substantive provisions of the requirements cited in this table are ARARs.
(c) Statutes and policies, and their citations, are provided as headings to identify general categories of potential ARARs for the convenience of the reader; listing the statutes and policies does not indicate that the DON accepts the entire statutes or policies as ARARs; specific ARARs are addressed in the table below each general heading; only pertinent substantive requirements of the specific citations are considered ARARs.

Acronyms/Abbreviations:
APCD – Air Pollution Control District
ARAR – applicable or relevant and appropriate requirement
CAA – Clean Air Act
CCR – *California Code of Regulations*
DON – Department of the Navy
POC – point of compliance
RCRA – Resource Conservation and Recovery Act
§– section
SIP – State Implementation Plan
TCLP – toxicity characteristic leaching procedure
tit. – title
USC – *United States Code*
U.S. EPA – United States Environmental Protection Agency

Table A2-2. State Chemical-Specific[a] ARARs

Requirement	Prerequisite	Citation[b]	ARAR Determination	Comments
SOIL AND AIR				
		Cal-EPA Department of Toxic Substances Control[c]		
Definition of "non-RCRA hazardous waste."	Waste.	CCR tit. 22, §66261.22(a)(3) and (4), §66261.24(a)(2)–(a)(8), §66261.101, §66261.3(a)(2)(C) or §66261.3(a)(2)(F)	Applicable	Substantive provisions are applicable for determining whether a waste is a non-RCRA hazardous waste.
Describes requirements for RWQCB oversight of investigation and cleanup and abatement activities resulting from discharges of hazardous substances. RWQCB may decide on cleanup and abatement goals and objectives for the protection of water quality and beneficial uses of water within each region. Establishes criteria for "containment zones" where cleanup to established water-quality goals is not economically or technically practicable.		Policies and procedures for investigation and cleanup and abatement of discharges under Cal. Water Code §13304, SWRCB Res. 92-49	Not an ARAR	Not an ARAR for soil cleanup.. The state does not agree with the DON determination that SWRCB Res. 92-49 is not ARAR for this removal action. However, the state agrees that the proposed action would comply with SWRCB Res. 92-49 and compliance with the CCR Title 22 provisions should result in compliance with the CCR Title 23 provisions. The state does not intend to dispute the Action Memorandum but reserves its rights if implementation of the CCR Title 22 provisions is not as stringent as state implementation of CCR Title 23 provisions. Whereas the DON and the State of California have not agreed on whether SWRCB Res. 92-49 is an ARAR for this removal action, this Action Memorandum documents each of the parties' positions on the resolution but does not attempt to resolve the issue. See Section A2.2.1.2 for more discussion.

Notes:
(a) Many action-specific ARARs contain chemical-specific limitations and are addressed in the action-specific ARAR tables.
(b) Only the substantive provisions of the requirements cited in this table are ARARs.
(c) Statutes and policies, and their citations, are provided as headings to identify general categories of potential ARARs for the convenience of the reader; listing the statutes and policies does not indicate that the DON accepts the entire statutes or policies as ARARs; specific ARARs are addressed in the table below each general heading; only pertinent substantive requirements of specific citations are considered ARARs.

Acronyms/Abbreviations:
ARAR – applicable or relevant and appropriate requirement
CCR – *California Code of Regulations*
Cal-EPA – California Environmental Protection Agency
Cal. Water Code – *California Water Code*
RCRA – Resource Conservation and Recovery Act
Res. – Resolution
RWQCB – (California) Regional Water Quality Control Board
§– section
SWRCB – (California) State Water Resources Control Board
tit. – title

Table A3-1. Federal Location-Specific ARARs

Location	Requirement	Prerequisite	Citation[a]	ARAR Determination	Comments
Exec. Order No. 11988, Floodplain Management[b]					
Within floodplain	Evaluate the potential effects of actions in a floodplain to avoid, to the extent possible, adverse effects associated with direct and indirect development of a floodplain and either avoid adverse impacts or minimize them if no practicable alternative exists.	Action that will occur in a floodplain (i.e., lowlands) and relatively flat areas adjoining inland and coastal waters and other flood-prone areas.	40 CFR §6.302(b) 40 CFR pt. 6, app. A, excluding §6(a)(2), 6(a)(4), and 6(a)(6)	Applicable.	Substantive provisions are applicable since proposed excavation and storage at Site 1111 is within a floodplain.
Resource Conservation and Recovery Act (42 USC §6901–6991[i]) [b]					
Within 100-year floodplain	Facility must be designed, constructed, operated, and maintained to avoid washout.	RCRA hazardous waste; treatment, storage, or disposal of hazardous waste.	CCR tit. 22, §66264.18(b)	Applicable	Substantive provisions are applicable if waste soil is RCRA hazardous waste because Site 1111 is within a floodplain.
Endangered Species Act of 1973 (16 USC §1531–1543) [b]					
Habitat upon which endangered species or threatened species depend	Federal agencies may not jeopardize the continued existence of any listed species or cause the destruction or adverse modification of critical habitat. The Endangered Species Committee may grant an exemption for agency action if reasonable mitigation and enhancement measures such as propagation, transplantation, and habitat acquisition and improvement are implemented.	Determination of effect upon endangered or threatened species or its habitat. Critical habitat upon which endangered species or threatened species depend.	16 USC §1536(a), (h)(1)(B)	Applicable	Substantive provisions are applicable at Site 1111 where habitat of the Arroyo southwestern toad, south-west Willow flycatcher and the least Bell's vireo exists and these species are suspected.
Migratory Bird Treaty Act of 1972 (16 USC §703–712) [b]					
Migratory bird area	Protects almost all species of native migratory birds in the U.S. from unregulated "take," which can include poisoning at hazardous waste sites.	Presence of migratory birds.	16 USC §703	Relevant and appropriate	Substantive provisions are relevant and appropriate for migratory birds observed in the vicinity and action is proposed that may affect birds.

Table A3-1. Federal Location-Specific ARARs (Continued)

Location	Requirement	Prerequisite	Citation[a]	ARAR Determination	Comments
Archaeological and Historic Preservation Act (16 USC Chapter 1A §469–469c-1) [b]					
Within area where action may cause irreparable harm, loss, or destruction of significant artifacts	Construction on previously undisturbed land would require an archaeological survey of the area. Data recovery and preservation would be required if significant archaeological or historical data were found on-site. The responsible official or Secretary of the Interior is authorized to undertake data recovery and preservation.	Regulated alteration of terrain caused as a result of a federal construction project or federally licensed activity or program where action may cause irreparable harm, loss, or destruction of significant artifacts.	16 USC §469	Applicable	Substantive provisions are applicable if excavation at Site 1111 enters areas previously undisturbed where there is a potential to affect archaeological or historical data.
Archaeological Resources Protection Act of 1979, as Amended (16 USC §470aa–470mm) [b]					
Within area where action may cause irreparable harm, loss, or destruction of significant artifacts	No person may excavate, remove, damage, or otherwise alter or deface, or attempt to excavate, remove, damage, or otherwise alter or deface any archaeological resource located on public lands unless such activity is in accordance with a permit. The archaeological resources which are excavated or removed from public lands will remain the property of the United States, and such resources and copies of associated archaeological records and data will be preserved by a suitable university, museum, or other scientific or educational institution.	Regulated alteration of terrain caused as a result of a federal construction project or federally licensed activity or program where action may cause irreparable harm, loss, or destruction of significant artifacts.	32 CFR 229.4 and 229.13(a)	Applicable	Substantive provisions are applicable for excavation at Site 1111 if it is determined that archaeological resources are potentially present in area of excavation.

Notes:
(a) Only the substantive provisions of the requirements cited in this table are ARARs.
(b) Statutes and policies, and their citations, are provided as headings to identify general categories of ARARs for the convenience of the reader; listing the statutes and policies does not indicate that the DON accepts the entire statutes or policies as ARARs; specific ARARs are addressed in the table below each general heading; only substantive requirements of the specific citations are considered ARARs.

Acronyms/Abbreviations:
ARAR – applicable or relevant and appropriate requirement
CFR – *Code of Federal Regulations*
DON – Department of the Navy
§– section
USC – United States Code

Table A3-2. State Location-Specific ARARs

Location	Requirement	Prerequisite	Citation[a]	ARAR Determination	Comments
California Endangered Species Act (Cal. Fish & Game Code §2050–2116)[b]					
Endangered species habitat	No person shall import, export, take, possess, or sell any endangered or threatened species or part or product thereof.	Threatened or endangered species determination on or before 01 January 1985 or a candidate species with proper notification.	Cal. Fish & Game Code §2080	Not an ARAR	Although no threatened or endangered state species Have been identified on-site, federal ARARs have been identified to protect habitat. Since the substantive state requirements for protecting habitat of threatened or endangered species or not more stringent, Cal. Fish & Game Code §2080 is not a potential ARAR.
Other California Fish and Game Requirements					
Within the floodplain	Prohibits the passage of enumerated substances or materials into waters of the state deleterious to fish, plant life, or birds.	Presence of enumerated substance.	Fish and Game Code §5650(a) and (f)	Relevant and appropriate	Substantive provisions may be relevant and appropriate for excavation at Site 1111 where materials might be placed where they could enter surface waters.
Bird and mammal habitat	Prohibits the taking of birds and mammals, including the taking by poison.	Presence of birds and mammals.	Fish and Game Code §3005(a)	Relevant and appropriate	Not an ARAR for federally protected species. Relevant and appropriate for remedial actions for non-federally protected species.
Bird habitat	It is unlawful to take, possess, or needlessly destroy the nest or eggs of any bird, except as otherwise provided.	Presence of birds and bird nests.	Fish and Game Code §3503	Relevant and appropriate	Not an ARAR for federally protected species. Potentially relevant and appropriate for remedial actions for non-federally protected species.
Bird habitat	It is unlawful to take, possess, or destroy any birds in the orders Falconiformes or Strigiformes (birds-of-prey) or to take, possess, or destroy the nest or eggs of any such bird except as otherwise provided.	Presence of birds and bird nests.	Fish and Game Code §3503.5	Relevant and appropriate	Not an ARAR for federally protected species. Potentially relevant and appropriate for remedial actions for the White-tailed Kite.

Table A3-2. Potential State Location-Specific ARARs (Continued)

Location	Requirement	Prerequisite	Citation[(a)]	ARAR Determination	Comments
Bird habitat	It is unlawful to take non-game birds except as provided.	Presence of non-game birds.	Fish and Game Code §3800(a)	Relevant and appropriate	Not an ARAR for federally protected species. Potentially relevant and appropriate for remedial actions for non-federally protected species.
Mammal habitat	A fur-bearing mammal may be taken only with a trap, a firearm, bow and arrow, poison under a proper permit, or with the use of dogs.	Presence of fur-bearing mammals.	Fish and Game Code §4002	Relevant and appropriate	Not an ARAR for federally protected species. Potentially relevant and appropriate for remedial actions for non-federally protected species.
Mammal habitat	Non-game mammals may not be taken or possessed except as provided.	Presence of non-game mammals.	Fish and Game Code §4150	Relevant and appropriate	Not an ARAR for federally protected species. Potentially relevant and appropriate for remedial actions for non-federally protected species.

Notes:
(a) Only the substantive provisions of the requirements cited in this table are ARARs.
(b) Statutes and policies, and their citations, are provided as headings to identify general categories of potential ARARs for the convenience of the reader; listing the statutes and policies does not indicate that the DON accepts the entire statutes or policies as ARARs; specific potential ARARs follow each general heading; only substantive requirements of the specific citations are considered ARARs.

Acronyms/Abbreviations:
ARAR – applicable or relevant and appropriate requirement
Cal. Fish & Game Code – *California Fish and Game Code*
§– section

Table A4-1. Federal Action-Specific ARARs

1 – No Further Action
2 – Institutional Controls
3 – Excavation, Off-Base Disposal, and Backfill

Action	Requirement	Prerequisite	Citation	ARAR Determination			Comments
				A	RA	TBC	
Resource Conservation and Recovery Act (42 USC §6901–6991[i])							
On-site waste generation	Person who generates waste shall determine if that waste is a hazardous waste.	Generator of waste.	CCR tit. 22, §66262.10(a) 66262.11	3			Applicable for operations where waste soil is generated. The determination of whether wastes generated during remedial activities are hazardous will be made at the time the wastes are generated.
	Requirements for analyzing waste for determining whether waste is hazardous.	Generator of waste.	CCR tit. 22, §66264.13(a) and (b)	3			Applicable for characterizing generated waste soil.
Hazardous waste accumulation	On-site hazardous waste accumulation is allowed for up to 90 days as long as the waste is stored in containers in accordance with §66262.171–178 or in tanks, on drip pads, inside buildings, is labeled and dated, etc.	Accumulate hazardous waste.	CCR tit. 22, §66262.34	3			Applicable for any operation where hazardous waste is generated. Generated waste soil that has the potential to be hazardous waste will be handled as hazardous during characterization. Waste determined to be hazardous will be disposed of within 90 days.
Container storage	Containers of RCRA hazardous waste must be: • Maintained in good condition, • Compatible with hazardous waste to be stored, and • Closed during storage except to add or remove waste.	Storage of RCRA hazardous waste not meeting small-quantity generator criteria before treatment, disposal, or storage elsewhere, in a container.	CCR tit. 22, §66264.171, .172, .173	3			Applicable for temporary storage of soil waste during characterization or, if hazardous, prior to off-site disposal. Temporary storage requirements may be relaxed by 264.553 below.
	Inspect container storage areas weekly for deterioration.	Storage of RCRA hazardous waste containers.	CCR tit. 22, §66264.174	3			Applicable for temporary storage of soil waste during characterization or, if hazardous, prior to off-site disposal. Temporary storage requirements may be relaxed by 264.553 below.

Table A4-1. Federal Action-Specific ARARs (Continued)

1 – No Further Action 2 – Institutional Controls 3 – Excavation, Off-Base Disposal, and Backfill							
				ARAR Determination			
Action	**Requirement**	**Prerequisite**	**Citation**	**A**	**RA**	**TBC**	**Comments**
Container storage (cont'd)	Place containers on a sloped, crack-free base, and protect from contact with accumulated liquid. Provide containment system with a capacity of 10% of the volume of containers of free liquids. Remove spilled or leaked waste in a timely manner to prevent overflow of the containment system.	Storage in a container of RCRA hazardous waste not meeting small-quantity generator criteria before treatment, disposal, or storage elsewhere.	CCR tit. 22, §66264.175(a) and (b)	3			Applicable for temporary storage of soil waste during characterization or, if hazardous, prior to off-site disposal. Temporary storage requirements may be relaxed by 264.553 below.
	Keep incompatible materials separate. Separate incompatible materials stored near each other by a dike or other barrier.	Hazardous waste.	CCR tit. 22 §66264.177	3			Potentially aApplicable for temporary storage of soil or groundwater waste during characterization or, if hazardous, prior to off-site disposal. Temporary storage requirements may be relaxed by 264.553 below.
	At closure, remove all hazardous waste and residues from the containment system, and decontaminate or remove all containers and liners.	Hazardous waste.	CCR tit. 22 §66264.178	3			Potentially Aapplicable for temporary storage of soil or groundwater waste during characterization or, if hazardous, prior to off-site disposal. Temporary storage requirements may be relaxed by 264.553 below.

Table A4-1. Federal Action-Specific ARARs (Continued)

1 – No Further Action
2 – Institutional Controls
3 – Excavation, Off-Base Disposal, and Backfill

Action	Requirement	Prerequisite	Citation	ARAR Determination			Comments
				A	RA	TBC	
Closure of staging pile	At closure, owner shall remove or decontaminate all waste residues, contaminated containment system components, contaminated subsoils, and structures and equipment contaminated with waste and leachate, and manage them as hazardous waste.	Waste pile used to store hazardous waste.	CCR tit. 22, §66264.258 (a)		3		Substantive provisions are relevant and appropriate for closure of staging piles.
Site closure	Minimize the need for further maintenance controls and minimize or eliminate, to the extent necessary to protect human health and the environment, postclosure escape of hazardous waste, hazardous constituents, leachate, contaminated rainfall or runoff, or waste decomposition products to groundwater or surface water or to the atmosphere.	Hazardous waste management facility.	CCR tit. 22, §66264.111(a) and (b)	3			Applicable for the closure of the staging piles.
Waste pile	Alternative requirements that are protective of human health or the environment may replace design, operating, or closure standards for temporary tanks and container storage areas.	Container storage area.	CCR tit. 22, §66264.553(b), (d), (e), and (f)	3			Applicable for waste containers stored for characterization or staging prior to off-site disposal.

Table A4-1. Federal Action-Specific ARARs (Continued)

1 – No Further Action 2 – Institutional Controls 3 – Excavation, Off-Base Disposal, and Backfill							
Action	**Requirement**	**Prerequisite**	**Citation**	**ARAR Determination**			**Comments**
				A	**RA**	**TBC**	
	Allows generators to accumulate solid remediation waste in a U.S. EPA-designated pile for storage only, up to 2 years, during remedial operations without triggering LDRs.	Hazardous remediation waste temporarily stored in piles.	40 CFR §264.554(d)(1)(i-ii) and (d)(2), (h), (i), (j), and (k)	3			Applicable for soil excavated and staged prior to characterization and off-site disposal.
Clean Water Act (42 USC §1342[p][3][A]							
Construction	Owners and operators of construction activities must be in compliance with discharge standards. All direct dischargers meet technology-based requirements including the best control technology and the best available technology economically achievable.	1 or more acres of soil disturbance	40 CFR §122.44(k)(2) and (4)	3			Applicable for the excavation action.

Note: Statutes and policies, and their citations, are provided as headings to identify general categories of potential ARARs for the convenience of the reader. Listing the statutes and policies does not indicate that the DON accepts the entire statutes or policies as ARARs; specific potential ARARs are addressed in the table below each general heading; only substantive requirements of specific citations are considered ARARs.

Acronyms/Abbreviations:
A – applicable
ARAR – applicable or relevant and appropriate requirement
CCR – *California Code of Regulations*
CFR – *Code of Federal Regulations*
LDR – land disposal restriction
RA – relevant and appropriate
RCRA – Resource Conservation and Recovery Act
§– section
TBC – to be considered
tit. – title
U.S. EPA – United States Environmental Protection Agency

Table A4-2. State Action-Specific ARARs

1 – No Further Action
2 – Institutional Controls
3 – Excavation, Off-Base Disposal, and Backfill

Action	Requirement	Prerequisite	Citation	ARAR Determination			Comments
				A	RA	TBC	
Actions affecting water quality	Establishes policies and procedures for the oversight of investigations and cleanup and abatement activities resulting from discharges of waste that affect or threaten water quality. Requires cleanup of all waste discharged and restoration of affected water to background conditions. Requires actions for cleanup and abatement to conform to Res. 68-16 and applicable provisions of CCR tit. 23, div. 3, ch. 15 as feasible.	Cleanup and discharge of groundwater to groundwater or surface water and establishment of containment zones.	SWRCB Res. 92-49 (Policies and Procedures for Investigation and Cleanup and Abatement of Discharges Under Cal. Water Code §13304) (Cal. Water Code §13307) (02 October 1996)				Not an ARAR. See Section A2.2.1.2 and Table A2-2.

Note: Statutes and policies, and their citations, are provided as headings to identify general categories of potential ARARs for the convenience of the reader; listing the statutes and policies does not indicate that the DON accepts the entire statutes or policies as ARARs; specific potential ARARs are addressed in the table below each general heading; only substantive requirements of the specific actions are considered ARARs.

Acronyms/Abbreviations:
A – applicable
ARAR – applicable or relevant and appropriate requirement
CCR – *California Code of Regulations*
Cal. Water Code – *California Water Code*
ch. – chapter
div. – division
RA – relevant and appropriate
Res. – resolution
RI – remedial investigation
SWRCB – (California) State Water Resources Control Board
TBC – to be considered
tit. – title

APPENDIX B

Cost Estimates

CONTENTS

TABLES

B1 INTRODUCTION

This appendix provides cost estimate information for soil removal alternatives for Site 1111 at Marine Corps Base (MCB) Camp Pendleton. These estimates were initially developed for the draft Feasibility Study (FS) for OU-5 Sites 1A-1, 6A, 21, 1111, and 12 Area (Parsons, 2005) and are presented in this Engineering Evaluation/Cost Analysis (EE/CA) as originally presented in the draft FS.

This appendix includes the general methodology for developing the cost estimates, and summarizes the general assumptions used in developing costs for the various options and alternatives. Specific cost analysis and cost estimates are presented in Tables B-1 through B-4.

B2 METHODOLOGY

Three sources of information were used to estimate costs for the detailed analysis of remedial action alternatives:

- R.S. Means Company, Inc., Environmental Restoration Assemblies Cost Book, 1997 for earthwork, backfill, and site restoration costs.
- Vendor quotations of capital and operations and maintenance (O&M) costs for off-base and on-base soil excavation, soil transport, soil stabilization, soil disposal, groundwater treatment system equipment, carbon addition, and chemical analysis of samples.
- Past project and professional experience in similar remediation projects for estimating pumping rates and duration, number of wells, number of confirmation samples, sample shipment, the cost of excavation, and backfilling.

B2.1 Cost Estimate Components

Cost estimates include capital costs, both direct and indirect costs, and annual O&M costs. Direct costs include work plan preparation (including a Health and Safety Plan [HSP], Quality Assurance Project Plan [QAPP], Sampling and Analysis Plan [SAP], and a Long-Term Monitoring Plan, where applicable), construction costs, equipment costs, land and site development costs, and building and services costs. Indirect capital costs include engineering expenses, mobilization/demobilization costs, and contingency allowances. Annual O&M costs include post-construction costs necessary to ensure the continued effectiveness of a removal action such as operating labor costs, maintenance materials, purchased services, residue disposal, and periodic site reviews.

B2.2 Accuracy of Cost Estimates

The accuracy of costs developed for alternatives in the EE/CA is an important consideration. According to regulatory guidance, "study estimate" costs for the EE/CA (or FS) are expected to be accurate to plus (+) 50 to minus (−) 30 percent (U.S. EPA, 1993). Parsons (2005) notes that the cost estimates for the alternatives identified in this EE/CA for Site 1111 soil removal actions fall within this range.

Where appropriate, contingency has been factored into the following cost estimates to account for unknowns, unforeseen circumstances, or unanticipated conditions that cannot be evaluated based on the currently available data. The use of contingencies helps reduce the risk of possible cost overruns as remedial alternatives are implemented. Two primary types of contingency were employed in the FS, which are scope and bid contingency. These contingencies have been retained in the cost estimates provided in this EE/CA. Scope contingencies address uncertainties due to scope changes that might occur during design due to limited experience with certain remedial technologies, potential changes in regulatory requirements or policy, or inaccuracies in estimated quantities or characteristics. Bid contingencies represent costs that cannot be foreseen at the time of the EE/CA preparation, which are likely to become known or better understood as the removal action progresses. It acknowledges the potential for changes in costs that occur after contracts are awarded, and typically represents a reserve for overruns, modifications, change orders, etc. For the purpose of this EE/CA, bid and scope contingencies are reflected as a combined percentage, specified as a line item.

B2.3 General Assumptions

Certain major assumptions were made to provide a basis for estimating the cost of various elements and components of alternatives. Assumptions that impact the cost estimates for several of the options and alternatives are identified in this section.

Excluded Costs

- Insurance, licensing, and taxes.

Capital Costs

- Prices for process equipment, treatment systems, and treatability studies are based on vendor quotes and on previous experience.
- Engineering and construction oversight costs are either variable percentages of capital costs or lump sum costs and are based on previous experience.
- Investigation-derived waste (IDW) disposal assumes non-hazardous wastes.
- Capital costs include the preparation of a Removal Action Work Plan (RAWP), a Health and Safety Plan (HASP), and a Sampling and Analysis Plan (SAP).

Operation and Maintenance Costs

- Labor cost includes costs for operational sampling, operation, and general maintenance.
- Health and safety costs are factored into the labor estimates and assumed Level D personal protection equipment (PPE) at temperatures less than 85°F.
- Analytical costs are based on vendor laboratory costs.

Periodic Costs

- Alternatives would be re-evaluated for effectiveness every 5 years.
- Periodic costs include updates to institutional controls plans, confirmation monitoring, demobilization of construction equipment, and site closure reports.

B3 COST ESTIMATES FOR THE SITE 1111 SOIL ALTERNATIVES

This section provides the cost estimates for the soil removal action alternatives for Site 1111 described in Section 4.0 of the main EE/CA document. A summary of the total cost for each of the Site 1111 alternatives is presented in Table B-1.

As a necessary precursor to estimating costs for Site 1111, the EE/CA evaluated soil potentially requiring removal from the standpoint of waste type (classification) and volume (lateral and vertical extent). Based on the concentrations for soil that exceeded remediation goals (RGs), the soil was preliminarily classified as RCRA-hazardous, California-hazardous, or non-hazardous waste. The waste classifications would only apply upon generation of a solid waste following excavation of the material (i.e., the material would not classify as a "waste" if left in situ). As such, the waste classifications are potentially relevant to soil excavated during the removal action.

The estimated volume of soil exceeding removal action objectives (RAOs) at Site 1111 was approximately 1,100 yd^3. Of the impacted material, approximately 50 percent of the total was assumed to be RCRA-hazardous waste and the other 50 percent was assumed to be California-hazardous waste. Using the estimated volumes, the cost estimates for the site-specific remedial alternatives were developed as discussed below.

B3.1 Alternative S1 – No Further Action

This alternative involves no additional actions to mitigate current site conditions and thus has no cost.

B3.2 Alternative S2 – Institutional Controls

Alternative S2 involves implementation of land use restrictions, monitoring the site for erosion and compliance with land use restrictions, and monitoring potential ecological impacts. To help ensure that this alternative is protective of ecological receptors, periodic biological surveys would be performed and a detailed, site-specific ecological risk assessment including collection of faunal tissue samples would be conducted. The capital and annual O&M cost estimates for this alternative are presented in Table B-2. The following are alternative-specific assumptions for Alternative S2:

- Capital cost includes a lump sum for administrative measures required for implementation of land use controls (estimated to be $75,000).
- Annual O&M costs include site monitoring for erosion control, continued compliance with land use restrictions, and potential ecological impacts.

If institutional controls were implemented, indirect costs would be associated with the base not being able to use the property for training and other purposes. Given that the base mission is to support training, any area with a land use restriction would limit that function. This potential loss of land use is not quantified in this document, but is considered as a factor in evaluating implementability of institutional controls as a removal alternative.

In summary, the estimated total cost of the alternative, which includes capital and O&M costs, is $475,000.

B3.3 Alternative S3 – Soil Excavation, Backfill, and Off-Base Disposal

Alternative S3 involves the excavation and off-base disposal of impacted soil. The approximate costs for a single excavation scenario were evaluated, involving excavation to the (variable) bottom of the burn debris, typically 5 to 15 ft bgs. Estimated costs are presented in Tables B-3 and B-4 and the underlying assumptions are summarized below:

- Access to site is granted without restriction.
- Approximate conversion factor from cubic yards to tons equals 1.5.
- Confirmation stockpile samples would be collected at a rate of one per every 500 tons of soil.
- Confirmation stockpile samples would be analyzed for soluble lead (STLC/TCLP).
- Materials with total lead concentrations less than 350 mg/kg and STLC concentrations less than 5.0 mg/L would be disposed of at the Waste Management Bradley facility as non-hazardous waste.
- Materials that have total lead concentrations greater than 350 mg/kg or STLC concentrations greater than 5.0 mg/L and TCLP concentrations less than 5.0 mg/L would be disposed of at the Waste Management Kettleman Hills facility as California-hazardous waste.
- Materials with TCLP concentrations greater than 5.0 mg/L would be stabilized and disposed of at the Waste Management Kettleman Hills facility as RCRA-hazardous waste.
- Portable scales would be used on-site to weigh trucks so that trucks leaving the base would not need to be weighed using the base scales.
- Air samples would be collected daily for the duration of the project. Four area air samples and three personal air samples would be collected each day of sampling.
- Manifests would be signed by a designated base representative.
- Approximately 600 tons of material would be removed from the site daily.
- Personnel working in the stabilization processing area would wear air-purifying respirators, chemically resistant gloves, and Tyvek for personal protective equipment.
- Work stoppages associated with base restrictions have not been included in this cost estimate.
- One confirmation sample would be collected below the excavated areas representing 400 ft^2 (20-ft by 20-ft grid) to confirm the effectiveness of this remedial alternative.

- Work would be performed during the day on 5-day/8-hour work shifts. No costs for overtime-hours or off-hours work has been included in this cost estimate.

- Workers would be paid at prevailing wage rates.

In summary, the estimated total cost for Alternative S3 is $699,000 for excavation to the (variable) bottom of the burn debris. Because the costs would be incurred over a relatively short time frame (i.e., less than one year), O&M is not anticipated.

Table B-1. Site 1111 Summary of Total Cost of Alternatives for Soil

Alternative	Description	Total O&M ($)	Capital Cost ($)	Total Cost ($)
S1	No Action	0	0	0
S2	Institutional Controls	220,000	75,000	475,000
S3	Soil Excavation, Backfill, Pretreatment, and Off-Base Disposal	0	699,000	699,000

Source: Parsons (2005).

Table B-2. Site 1111 Alternative S2: Institutional Controls Cumulative Cost Estimate

Year	Annual O&M[a] ($)	Capital[b] ($)	Cumulative Cost ($)
0	0	75,000	75,000
1	5,000	0	80,000
2	5,000	0	85,000
3	5,000	0	90,000
4	5,000	0	95,000
5	5,000	0	100,000
5[c]	40,000	0	140,000
6	5,000	0	145,000
7	5,000	0	150,000
8	5,000	0	155,000
9	5,000	0	160,000
10	5,000	0	175,000
10[c]	40,000	0	215,000
11	5,000	0	220,000
12	5,000	0	225,000
13	5,000	0	230,000
14	5,000	0	235,000
15	5,000	0	240,000
15[c]	40,000	0	280,000
16	5,000	0	285,000
17	5,000	0	290,000
18	5,000	0	295,000
19	5,000	0	300,000
20	5,000	0	305,000
20[c]	40,000	0	345,000
21	5,000	0	350,000
22	5,000	0	355,000
23	5,000	0	360,000
24	5,000	0	365,000
25	5,000	0	370,000
25[c]	40,000	0	410,000
26	5,000	0	415,000
27	5,000	0	420,000
28	5,000	0	425,000
29	5,000	0	430,000
30	5,000	0	435,000
30[c]	40,000	0	475,000
TOTAL FOR ALTERNATIVE 2		**75,000**	**475,000**

(a) Annual O&M costs include site monitoring for erosion, land use, and ecological impact, and quadrennial surveys.
(b) Capital cost includes a lump sum cost for administrative measures required for implementation of land use controls (estimated to be $75,000).
(c) Indicates costs associated with preparation of Five-Year Reviews (U.S. EPA, 2004a).
Source: Parsons (2005).

Table B-3. Site 1111 Alternative S3: Excavation, Backfill, and Off-Base Disposal Total Estimated Costs (Source: Parsons, 2005)

Professional Category Standard Billing Rate ($/hr)	Sr. Tech. Dir. $126.07	Proj. Mgr. $114.39	Sup. Engineer $115.40	Sr. Engineer $86.98	Engineer $65.95	Sup. Scientist $109.09	Sr. Scientist $69.62	Scientist $53.41	Sup. Specialist $73.90	Sr. Spec. I $42.57	Total Hours	Total Labor $	Total ODCs $	Subtotal Cost	Total Cost
Task 1 - Planning, Direction, Oversight, Scheduling, Meetings, and Scope Preparation															
Planning	4	20	20	0	0	20	0	0	10	10	84	$ 8,446.58	$ -	$ 8,446.58	
Direction and Oversight	4	8	8	0	0	8	0	0	0	0	28	$ 3,215.32	$ -	$ 3,215.32	
Schedule Preparation and Implementation	4	8	8	0	0	8	0	0	0	0	28	$ 3,215.32	$ -	$ 3,215.32	
Meetings	4	8	8	0	0	8	0	0	0	0	28	$ 3,215.32	$ -	$ 3,215.32	
Scope Preparation	4	8	8	0	0	8	0	0	0	0	28	$ 3,215.32	$ -	$ 3,215.32	
ODCs - Subcontractors	0	0	0	0	0	0	0	0	0	0	0	$ -	$ 3,000.00	$ 3,000.00	
Total Cost for Task 1															$ 24,307.86
Task 2 - Mobilization															
Mobilization	2	4	4	0	20	4	0	20	0	0	54	$ 3,994.86	$ -	$ 3,994.86	
ODC - Subcontractor	0	0	0	0	0	0	0	0	0	0	0	$ -	$ 10,000.00	$ 10,000.00	
Total Cost for Task 2															$ 13,994.86
Task 3 - Excavation/Stockpiling of Impacted Soil															
Excavation Oversight	4	20	40	0	0	0	0	0	0	0	64	$ 7,408.08	$ -	$ 7,408.08	
Soil Stockpile Confirmation Sampling	0	0	0	0	40	0	0	40	0	0	80	$ 4,774.40	$ -	$ 4,774.40	
Air Monitoring	0	0	0	0	0	0	0	0	0	0	0	$ -	$ -	$ -	
ODC - Subcontractor	0	0	0	0	0	0	0	0	0	0	0	$ -	$ 70,942.75	$ 70,942.75	
Total Cost for Task 3															$ 83,125.23
Task 4 - Transport and Disposal of Soil															
Manifest Tracking and Oversight	4	20	40	0	40	0	0	40	0	0	144	$ 12,182.48	$ -	$ 12,182.48	
ODC - Subcontractor	0	0	0	0	0	0	0	0	0	0	0	$ -	$ 258,500.00	$ 258,500.00	
Total Cost for Task 4															$ 270,682.48
Task 5 - In-Situ Confirmation Sampling															
Sample Collection	0	4	10	0	20	0	0	0	0	0	34	$ 2,930.56	$ -	$ 2,930.56	
ODC-Subcontractor	0	0	0	0	0	0	0	0	0	0	0	$ -	$ 17,920.00	$ 17,920.00	
Total Cost for Task 5															$ 20,850.56
Task 6 - Backfill and Compaction															
Backfill/Compaction Oversight	0	10	40	0	40	0	0	0	0	0	90	$ 8,397.90	$ -	$ 8,397.90	
ODC - Subcontractor	0	0	0	0	0	0	0	0	0	0	0	$ -	$ 99,025.25	$ 99,025.25	
Total Cost for Task 6															$ 107,423.15
Task 7 - Reporting															
Draft Report Preparation	4	40	40	20	0	20	0	20	20	20	184	$ 18,333.88	$ -	$ 18,333.88	
Incorporate Comments from MCB and Regulators	2	20	20	10	0	10	0	10	10	10	92	$ 9,166.94	$ -	$ 9,166.94	
Finalize Report	2	10	10	10	0	10	0	10	10	10	72	$ 6,869.04	$ -	$ 6,869.04	
Total Cost for Task 7															$ 34,369.86
Other Direct Costs - Parsons (5% of Project Total)	0	0	0	0	0	0	0	0	0	0	0	$ -	$ 27,737.70	$ 27,737.70	$ 27,737.70
Contingency (20%=10%[Bid]+10%[Scope])															$ 116,498.34
Total	38	180	256	40	160	96	0	140	50	50	1010	$ 95,366.00	$ 487,125.70		$ 698,990.04

ASSUMPTIONS:

Access to site is granted without restriction
Conversion factor from in-situ cubic yards to ex-situ cubic yards (fluff) = 1.3
Conversion factor from cubic yards to tons = 1.5
Confirmation samples will be collected from stockpiles to determine ultimate disposition of soil (1 per 500 tons)
Confirmation stockpile samples will be analyzed for soluble metals, soluble dioxins and soluble pesticides (STLC/TCLP)
Materials with total concentrations <10 X the STLC will be deposited at Waste Management Bradley Facility as Non-Haz
Materials with total concentrations >10 X the STLC will be analyzed using a Waste Extraction Test (WET). Results from the WET will be compared to the STCL value for the individual constituent. If WET results exceed the STLC, a Toxicity Characteristic Leaching Potential (TCLP) test will be performed.
Materials with WET concentrations greater than the STLC but less than the TCLP will be deposited in the Waste Management Kettleman Hills Facility as CA-Haz
Materials with concentrations greater than the TCLP will be transported and disposed at the Waste Management Kettleman Hills Facility as RCRA-Haz
Portable scales will be used on-site to weigh trucks so that trucks leaving the Base will not need to be weighed using the Base scales
Air samples will be collected on a daily basis for the duration of the project. Four area air samples and three personal air samples will be collected each day of sampling
Manifests will be signed by a designated Base representative
Approximately 500 tons of material will be removed from the Site on a daily basis
Work stoppages associated with Base restrictions have not been included in this cost estimate
Confirmation samples will be collected which will be representative of approximately 400 square feet (20'X20') to confirm the effectiveness of this remedial alternative
Work will be performed during the day on 5-day/8-hour work shifts. No costs for overtime hours or off hours work has been included in this cost estimate
Workers will be paid at prevailing wage rates
50% of Material removed will be RCRA Hazardous
50% of Material removed will be CA Hazardous

Table B-4. Site 1111 Alternative S3: Excavation, Backfill, and Off-Base Disposal Detailed Subcontractor Costs (Source: Parsons, 2005)

Description of Subcontractor Costs Standard Billing Rate ($/hr)	Unit Rate	Units	Subtotal	Total Subcontractor Costs
Task 1 - Planning, Direction, Oversight, Scheduling, Meetings, and Scope Preparation				
Subcontractor (WMI)	$ 1,000.00	1	$ 1,000.00	
Subcontractor (NRC Env)	$ 1,000.00	1	$ 1,000.00	
Subcontractor (CalScience)	$ 1,000.00	1	$ 1,000.00	
Subtotal for Subcontractors - Task 1				**$ 3,000.00**
Task 2 - Mobilization (Lump Sum)				
Subcontractor (NRC Env)	$ 10,000.00	1	$ 10,000.00	
Subtotal for Subcontractors - Task 2				**$ 10,000.00**
Task 3 - Excavation/Stockpiling/Loading of Impacted Soil				
Subcontractor (NRC Env) 5 Working Days @ 8 Hours/day for Excavation of Material				
Project Manager (0.5) Hourly	$ 115.00	20	$ 2,300.00	
Project Superintendent (1) Hourly	$ 97.75	40	$ 3,910.00	
Operator (2) Hourly	$ 72.45	80	$ 5,796.00	
Driver (1) Hourly	$ 72.45	40	$ 2,898.00	
Laborer (2) Hourly	$ 51.75	80	$ 4,140.00	
CAT 235 Trackhoe (1) Daily including fuel	$ 1,115.50	5	$ 5,577.50	
CAT 950 Loader (1) Daily including fuel	$ 632.50	5	$ 3,162.50	
Water Trucks, 4,000 Gallon (1) Daily including fuel	$ 603.75	5	$ 3,018.75	
NRC Env Other Direct Costs	$ 250.00	5	$ 1,250.00	
Subcontractor (CalScience) Stockpile Samples				
VOCs (EPA Method 8260) 24 hour TAT	$ 250.00	5	$ 1,250.00	
SVOCs (EPA Method 8270) 24 hour TAT	$ 500.00	5	$ 2,500.00	
Pesticides/Herbicides (EPA Method 8080) 24 hour TAT	$ 300.00	5	$ 1,500.00	
Title 22 Metals (EPA Method 6010/7000) 24-hour TAT	$ 230.00	5	$ 1,150.00	
STLC (Waste Extraction Test and Analysis) 24-hour TAT	$ 92.00	5	$ 460.00	
TCLP (TCLP Extraction and Analysis) 24-hour TAT	$ 92.00	5	$ 460.00	
Subcontractor (EMS) Air Monitoring Samples				
Metals Analysis (except hex chromium) 24 hour TAT	$ 92.00	35	$ 3,220.00	
Metals Analysis (hex chromium) 24 hour TAT	$ 92.00	35	$ 3,220.00	
Total Dust 24 hour TAT	$ 30.00	35	$ 1,050.00	
Respirable Dust 24 hour TAT	$ 30.00	35	$ 1,050.00	
Total Silica (includes crocidolite and trydimite) 24 hour TAT	$ 329.00	35	$ 11,515.00	
Respirable Silica (includes crocidolite and trydimite) 24 hour TAT	$ 329.00	35	$ 11,515.00	
Subtotal for Subcontractors - Task 3				**$ 70,942.75**
Task 4 - Transport and Disposal of Soil				
Subcontractor (WMI)				
Transport and Disposal of RCRA Hazardous Material to WMI Kettleman Hills Facility	$ 150.00	1100	$ 165,000.00	
Transport and Disposal of CA Hazardous Material to WMI Kettleman Hills Facility	$ 85.00	1100	$ 93,500.00	
Subtotal for Subcontractors - Task 4				**$ 258,500.00**
Task 5 - In-Situ Confirmation Sampling				
Subcontractor (CalScience) Stockpile Samples				
VOCs (EPA Method 8260) 24 hour TAT	$ 250.00	14	$ 3,500.00	
SVOCs (EPA Method 8270) 24 hour TAT	$ 500.00	14	$ 7,000.00	
Pesticides/Herbicides (EPA Method 8080) 24 hour TAT	$ 300.00	14	$ 4,200.00	
Title 22 Metals (EPA Method 6010/7000) 24 hour TAT	$ 230.00	14	$ 3,220.00	
Subtotal for Subcontractors - Task 5				**$ 17,920.00**
Task 6 - Backfill and Compaction				
Subcontractor (WMI)				
Backfill Material	$ 15.00	2200	$ 33,000.00	
Subcontractor (NRC Env) 5 Working Days @ 8 Hours/day for Backfill and Compaction of Material				
Project Manager (0.5) Hourly	$ 115.00	20	$ 2,300.00	
Project Superintendent (1) Hourly	$ 97.75	40	$ 3,910.00	
Operator (2) Hourly	$ 72.45	80	$ 5,796.00	
Driver (1) Hourly	$ 72.45	40	$ 2,898.00	
Laborer (2) Hourly	$ 51.75	80	$ 4,140.00	
D-6 Dozer (1) Daily including fuel	$ 805.00	5	$ 4,025.00	
Roller Compactor (1) Daily including fuel	$ 747.50	5	$ 3,737.50	
Water Trucks, 4,000 Gallon (1) Daily including fuel	$ 603.75	5	$ 3,018.75	
NRC Env Other Direct Costs	$ 250.00	5	$ 1,250.00	
Subcontractor (Smith Emery) 5 Working Days @ 8 Hours/day for Backfill and Compaction of Material				
Project Manager (1 hour per day) Hourly	$ 100.00	5	$ 500.00	
Soils Technician (1) Hourly	$ 80.00	40	$ 3,200.00	
Smith Emery Other Direct Costs	$ 250.00	5	$ 1,250.00	
Subcontractor (Surveying)	$ 5,000.00	1	$ 5,000.00	
Subcontractor (Revegetation)	$ 25,000.00	1	$ 25,000.00	
Subtotal for Subcontractors - Task 6				**$ 99,025.25**
ODC Subcontractor Total				**$ 459,388.00**

APPENDIX C

Responses to Agency Comments on Draft EE/CA

NO.	SECTION	PAGE	COMMENT	RESPONSE	REVISION
			***Comments From:* Beatrice Griffey, San Diego Regional Water Quality Control Board:**		
1	**General**		Due to the spatial extent of the proposed excavation, lateral and vertical, there is a possibility that significant waste will remain at the Site following removal action implementation. As an example, elevated concentrations of VOCs (~59 mg/kg) are present in the vicinity of former boring 1111SB-09 at 6 feet bgs, which is the proposed maximum depth of the excavation. Additionally, elevated concentrations of pesticides are present in the vicinity of former boring 1111SB-17, located immediately adjacent to the southwestern extent of the proposed excavation.	We acknowledge that there is some uncertainty as to whether or not the proposed excavation "footprint" perfectly delineates the area/depth of soil containing COCs above RGs. To assess the level of uncertainty, we've prepared a plan view and cross-section concentration isopleth map/figure for each COC to illustrate the lateral and vertical extent of soil with concentrations above the RG for that chemical. These figures have been included in this appendix. Each figure includes an isopleth corresponding to the RG for that chemical which delineates the area and depth of soil that exceeds the RG. In general, these figures show that the majority of the contaminated soil occurs within the proposed excavation area/depth; however, there is a potential for soil with COC concentrations above RGs to exist outside the proposed excavation area and below the target excavation depth (6 ft bgs) in a couple locations. In particular, contamination may extend beyond the proposed excavation boundary in the area near SB-09 because several COCs (VOCs) are present at this location above RGs (see isopleth maps for methylene chloride, naphthalene, etc). The maps/figures also suggest that it may be necessary to excavate deeper than 6 ft bgs in the area between SB-19 and MW-03, where DDE is predicted to occur at concentrations above RGs at a depth slightly greater than this depth (approximately 7 ft), and also in the vicinity of B03 where mercury is predicted to occur at concentrations above RGs at a depth slightly greater than this depth (approximately 7 ft bgs). Other locations where contamination may extend slightly deeper than 6 ft include the area near	No revision was required. However, pre-excavation confirmation sampling (PECS) will be conducted to verify vertical and lateral limits of excavation (pending regulator approval). Following PECS, it may be necessary to adjust target excavation depths. An excavation plan based on the PECS data will be prepared and provided in

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				SB-19 (DDE and DDT), the area between B02 and B03 (DDT and DDE), and the area near SB-09 (several VOCs). The intent of the removal action is to remove all soil containing concentrations of COCs above RGs. Confirmation samples will be collected to ensure that residual soil doesn't contain COCs above RGs. If confirmation samples indicate that COCs are present above RGs, the boundaries of the excavation will be expanded as needed to achieve the goal. The proposed confirmation sampling locations are shown on Figure C-1 (attached). One way to further reduce the uncertainty in the excavation is to conduct the confirmation sampling before the excavation (i.e., "Pre-Excavation Confirmation Sampling" [PECS]). The purpose of the PECS would be twofold: 1) confirm the vertical and lateral limits of soil with COC concentrations above RGs *prior* to excavation; and, 2) serve as confirmation sampling in lieu of traditional post-excavation confirmation sampling. The Navy has implemented this approach at other sites where there is a potential to encounter groundwater during a soil excavation. Generally, we've found that samples collected prior to excavation are more representative of in-situ conditions than samples collected during/after excavation due to the potential for saturated soil to slough/blend. PECS samples will be collected from perimeter and floor locations as indicated on Figure C-1. Table C-1 details the proposed sampling depths for	the Final RAWP.

NO.	SECTION	PAGE	COMMENT	RESPONSE	REVISION
				each PECS location. Sampling and analysis procedures for floor and perimeter sampling locations are detailed below. **Floor Sampling Locations:** Floor samples are intended to bound the vertical extent of excavation. Floor samples will be collected at a total of eight (8) locations in the floor of the excavation. Two soil samples will be collected at each floor location at the depths indicated on Table C-1. The uppermost sample would be collected at a depth immediately below the target excavation depth at that location, i.e., the proposed sampling depth for the uppermost subsurface sample at each location is slightly greater than the depth where COCs were detected in the nearest soil boring(s). The target depth has been pre-selected based on the COC plan view and cross-section contaminant isopleth maps that have been provided. The second sample would be collected from a depth approximately 1 to 2 ft below the first sample. Both samples from each boring would be submitted for analysis of target analytes required for confirmation sampling; however, the second sample would be held and analyzed only if the uppermost sample contained one or more COCs at concentrations above RGs. **Perimeter Sampling Locations:** Perimeter samples are intended to bound the lateral extent of excavation. Perimeter samples will be collected at a minimum of nine (9) locations. Each perimeter sample location has been	

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				conservatively located outside the estimated horizontal extent of contamination. At each perimeter location, a surface sample and two subsurface samples will be collected at the depths indicated on Table C-1. The proposed sampling depth for the *uppermost* subsurface sample at each location corresponds to the depth where COCs were detected in the nearest soil boring(s). The sampling depth for the *lowermost* subsurface sample at each location is slightly greater than the depth where COCs were detected in the nearest soil boring(s). As with floor samples, the lowermost subsurface sample will be held and analyzed only if the uppermost subsurface sample contains one or more COCs above RGs. • If the surface sample and the uppermost subsurface sample from that location do not contain any COCs above RGs, then that sampling location will be used to bound the lateral extent of the excavation. • If the surface sample contains one or more COCs above RGs, then the sample location will be considered a floor sample location and the subsurface samples will be analyzed using the protocol described for floor sampling locations. These subsurface samples will provide data to bound the vertical extent of contamination at this location. An additional perimeter	

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				sample will be collected at a new "step-out" location from the initial perimeter location. This process will continue until the lateral extent of excavation has been determined. Also – see response to comment #9 below.	
2	**General**		The proposed water quality based remedial goals (MCLs) specifically and solely address human health issues and are not protective of aquatic ecosystems. Since there are surface water bodies adjacent to and down gradient of the Site, there is a possibility that the plume originating from IR Site 1111 may migrate in the subsurface environment and discharge into the surface waters and adversely affect aquatic ecosystems.	Following the (soil) removal action, the Navy intends to conduct groundwater monitoring at Site 1111. If groundwater contamination exists above groundwater RGs established in the FS for this site, then the Navy will proceed with groundwater remediation at that time per the alternatives evaluated in the FS and selected in the ROD (assuming the ROD is complete at this time). As an aside, it doesn't appear that groundwater at this site is likely to pose an unacceptable threat to surface water ecological receptors. Tables C-2 and C-3 (attached) list constituents detected in groundwater in 1998 and 2001-2003, respectively, along with applicable surface water criteria that are protective of aquatic organisms. Based on a very conservative comparison of maximum detected concentrations vs surface water criteria, only one constituent (mercury) was detected in groundwater (one location in 1998 and one location in 2001-2003) at a level that exceeds surface water criteria.	No revision was required. This concern will be addressed as a groundwater issue.
3	**General**		The method used to establish remedial goals only considers IR Site 1111 as a sole source of contamination to ground water and does not take into consideration the presence of ground water contamination originating from former IR Site 3 (former pesticide control wash rack), located	Following the (soil) removal action, the Navy intends to conduct groundwater monitoring at Site 1111. If groundwater contamination exists above groundwater RGs established in the FS for this site, then the Navy will proceed with groundwater remediation at that time per the alternatives	No revision was required. This concern will be addressed as

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			immediately adjacent to and upgradient of IR Site 1111. Whereas contaminant concentrations leaching individually from adjacent sites may not pose a significant threat to water quality, i.e. exceed the most stringent water quality criteria, there is a possibility that plumes originating from adjacent sites will commingle in the subsurface environment and significantly impair the quality of waters of the State. This is a known significant environmental issue at other contaminated sites within the State (Marschack, 1989).	evaluated in the FS and selected in the ROD (assuming the ROD is complete at this time).	a groundwater issue.
***Comments From:* Tayseer Mahmoud, San Diego Department of Toxic Substances Control:**					
4	**General**		DTSC recommends changing the title of the document to read as follows: "EE/CA Non-Time Critical Removal Action for Interim Removal Action at Site 1111". The change is needed because the response action is limited to soil only and does not include groundwater. The groundwater remedial alternatives are evaluated in the Feasibility Study (FS) for OU 5. Also, include a statement in the EE/CA and AM that the final remedy for Site 1111 will be selected in the FS phase currently planned for 2006. The proposed interim action is designed, however, to be compatible with and potentially comprise the final remedy at Site 1111.	The suggested change has been incorporated into the revised (Final) version of the EE/CA and AM. The suggested language has been incorporated into the revised (Final) version of the EE/CA and AM.	Yes, the document title has been changed to the suggested title. The suggested language has been added to the text.
5	**3.3 (EE/CA); 3.5 (AM)**	**26 (EE/CA); 20 (AM)**	EE/CA Section 3.3 and AM Section 3.5 Remediation Goals: The selected cleanup goals value of 2,026 micrograms per kilogram (µg/KG) for DDD/DDE/DDT is less stringent than cleanup goals for each chemical separately. DTSC recommend the more stringent value for DDT. In	Individual RGs have been established for these three pesticides as follows: 2,026 µg/kg (DDD), 1,430 µg/kg (DDE), and 1,719 µg/kg (DDT). These RGs are based on human health protection. Table C-4 (attached) summarizes the revised RGs for soil COCs at this site.	Yes, the text has been modified to clarify RGs for DDD, DDE, DDT.

NO.	SECTION	PAGE	COMMENT	RESPONSE	REVISION
			addition, the DDT human health risk-based (RBC) remediation goal should be selected because it is more stringent than soil removal goals of 2,450 µg/kg to meet groundwater protection.		
6	4.3.3 (EE/CA); 5.0 (AM)	39 (EE/CA); 25 (AM)	EE/CA Section 4.3.3 and AM Section 5.0 Confirmation Sampling and Analysis of Excavation Areas: The EE/CA lists VOCs, SVOCs, and metals as contaminants of concern (COCs) at the site while the AM lists VOCs, SVOCs, metals, and dioxins as COCs. Confirmation samples should be analyzed for all COCs including pesticides. Also, test method 8270C does not achieve detection limits lower than the RBCs for SVOCs detected at the site. Please use the 8270C Selected Ion Monitoring (SIM) technique to achieve the desired lower detection limits. Although RBCs were developed for each COC at Site 1111, the cumulative risk and hazard index associated with detected concentrations in confirmation sampling should be presented in a closure report for the site.	Pre-Excavation Confirmation Samples (PECS) will be analyzed for all COCs, including: VOCs, SVOCs, pesticides, metals, and dioxins that are considered COCs. Table C-5 (attached) lists the analyses that will be performed on confirmation samples. The text has been revised to clarify the proposed analyses for confirmation samples. Also, the RAWP provides a full description of the analytical protocol for confirmation samples. To achieve the desired reporting limits for SVOCs, samples will be analyzed using LVI-GC/MS (Large Volume Injection-Gas Chromatography/Mass Spectrometry) following EPA method 8270. This is a full mass spectra analysis, not SIM (Selective Ion Mode). A post excavation risk assessment will be conducted and presented as part of the closure report for the site. The risk assessment will include an evaluation of the risk to residential receptors and will be based on data from the pre-excavation confirmation sampling. PECS data from the upper 10 ft of soil will be used to calculate residential risks since exposure to soil below this depth isn't plausible. If the depth to groundwater is less than 10 ft, data from the soil column above the water table will be used to calculate risk. Exposure point concentrations for the risk assessment will be the 95% upper	Yes, the text has been modified to clarify COCs and proposed confirmation sample analyses.

NO.	SECTION	PAGE	COMMENT	RESPONSE	REVISION
				confidence of the mean concentration.	
7	Appendix B (EE/CA)	B-8 (EE/CA)	Appendix B Cost Estimate: Table B-3 lists confirmation stockpile samples to be analyzed for metals, dioxins, and pesticides. The sampling and analysis of soil stockpile on page 38 of the EE/CA and page 27 of the AM proposes lead analysis only. Please note that the disposal facility may require analysis for all COCs detected at the site. In addition, please revise the foot note to include total metals analysis performed first to determine if a sample is hazardous by exceeding the corresponding Total Threshold Limit Concentration (TTLC) listed in Section 66261.24, Table II, Title 22, CCR. If the concentrations are above the TTLC the soil is considered a California hazardous waste. If the value is less than TTLC but greater than 10 times the corresponding Soluble Threshold Limit Concentration (STLC) value, a Waste Extraction Test (WET) will be performed. If the concentration of a substance in the (WET) extract is greater than the corresponding STLC, then the waste is a California hazardous. If a sample	The text has been revised as requested. During preparation of the EE/CA and AM, Battelle compiled historical sampling data for Site 1111 and presented it to potential landfill vendors who indicated that stockpile analysis would only be necessary for lead; thus, a decision was made in the EE/CA and AM that stockpile samples would be analyzed only be conducted for this contaminant. After issuing the Draft EE/CA and AM and while preparing the Removal Action Work Plan (RAWP) for the Site 1111 removal action, it was decided that a more extensive stockpile analytical protocol is needed based on the number and diversity of contaminants present in the soil at Site 1111. The revised recommended analytical protocol for stockpile samples is provided on Table C-6 (attached). The foot note has been revised so as to be consistent with the text in Section 4.3.3.1. In addition, the RAWP provides a full description of the analytical protocol for stockpile samples.	Yes, the text has been modified to clarify proposed stockpile sample analyses.

NO.	SECTION	PAGE	COMMENT	RESPONSE	REVISION
			contains concentrations greater than 10 times the STLC, a RCRA determination is required by conducting a Toxicity Characteristic Leaching Procedure (TCLP) test. The waste is considered a RCRA hazardous waste if the analysis results exceed the TCLP value.		
			***Comments From:* Bill Mabey, Techlaw/United States Environmental Protection Agency:**		
8	**General**		It is unclear whether the confirmation sampling will analyze for only the 2,3,7,8-TCDD congener, or will all dioxin/furans be analyzed and the results presented as 2,3,7,8-TCDD toxicity equivalents? This EE/CA can be read that either will be done, so some clarification now seems useful.	Confirmation samples will be analyzed for the full suite of dioxins/furans and these results will be used to calculate a 2,3,7,8-TCDD toxicity equivalent quotient (TEQ) to compare to the dioxin/furan RG, which is expressed as 2,3,7,8-TCDD TEQ.	Yes, the text has been modified to clarify that a full suite of dioxin/furan congeners will be analyzed, and that the results will be used to calculate the 2,3,7,8-TCDD TEQ for each confirmation sample.
9	**4.3.3.1 (EE/CA)**	**39**	The last sentence on page 39 of the EE/CA, first paragraph, states "If soils below the water table are impacted with soil COCs above RGs and are not able to be excavated during this removal action, it is assumed that a suitable remedy will be selected to treat both groundwater and saturated soils during preparation of the OU-5 ROD." However, if the Navy backfills the	The intent of the removal action is to remove soil to the extent necessary to achieve the RAOs for this removal action. Specifically, the following criteria will be used to define the required area/depth of excavation to meet the RAOs: **RAO #1.** *Reduce human health risk at the site to levels acceptable for unrestricted (i.e., residential)*	Yes, the text has been modified to clarify the criteria that will be used to define the required

NO.	SECTION	PAGE	COMMENT	RESPONSE	REVISION
			excavation - then implementation of a subsequent remedy per the ROD becomes more difficult and certainly more expensive. While a remedy for VOCs after backfilling is credible, available remedies for SVOCs, metals and dioxin/furans become problematic in subsurface soils. If the Navy is even considering advocating NFA for SVOCs, dioxins/furans, and metals (ouch!) after backfilling, then let's discuss that now. The Navy and agencies have been down a parallel road before with Site 1A, so this *groundwater* issue needs to be clarified before excavation begins.	*land use so that the site can be closed following the removal action, without institutional controls or long-term monitoring.* **RAO #1 Criteria.** COCs that are a threat to human health must not be present at a concentration above their respective human health risk based RG in the uppermost 10 feet of soil (or in the soil column above the water table if the depth to groundwater is less than 10 ft). For the purpose of this criteria, the water table will be defined as the lowest water table elevation recorded at this site for the period of record (December 2001). Of the 21 COCs at this site, 16 are human health COCs, including dixons/furans, 3 VOCs, 1 SVOC (hexachlorobenzene), 3 pesticides (DDD/DDE/DDT), and 8 metals. Table C-4 (attached) identifies the COCs. **RAO #2.** *Minimize exposure of chemicals in soil to ecological receptors at concentrations that pose a potentially significant risk.* **RAO #2 Criteria.** COCs that are a threat to ecological risk must not be present at a concentration above their respective ecological risk-based RG in the uppermost 5 ft of soil (the uppermost 5 ft of soil corresponds to the exposure interval for potential ecological receptors at this site). Of the 21 COCs at this site, 4 are ecological COCs, including dioxins/furans, hexachlorobenzene, antimony, and mercury. Table C-4 (attached) identifies the COCs.	limits of excavation in order to achieve the RAOs. Also, measures for dealing with wet soil, including PECS, are described in the RAWP. An excavation plan to achieve RAOs that is based on the PECS data will be prepared and provided in the Final RAWP.

NO.	SECTION	PAGE	COMMENT	RESPONSE	REVISION
				RAO #3. *Protect the beneficial uses and water quality objectives of the lower Santa Margarita River basin.* **RAO #3 Criteria.** COCs that are a threat to the groundwater's beneficial uses must not be present in the soil column above the water table at a concentration above their respective RG that is based on protection of groundwater. Soil that is below the water table can contain these COCs at a concentration above the COC's groundwater protection RG provided that groundwater that is in contact with the soil doesn't contain concentrations of these contaminants above levels that are protective of the groundwater's beneficial uses. For the purpose of this criteria, the water table will be defined as the lowest water table elevation recorded at this site for the period of record (December 2001). Of the 21 COCs at this site, 12 pose a threat to groundwater quality, including 7 VOCs, 2 SVOCs, and 3 pesticides. Table C-4 (attached) identifies the COCs. In addition, we recognize that the shallow groundwater condition at the site could hinder excavation and potentially interfere with achieving the RAOs; therefore, we're planning to implement the following measures. First, as discussed previously, PECS will be conducted prior to initiating the soil removal action to verify the required limits of excavation. Once the PECS data area available, it will be possible to determine whether or not it is likely that	

NO.	SECTION	PAGE	COMMENT	RESPONSE	REVISION
				groundwater COCs are present below the water table at concentrations above RGs and thus whether or not groundwater remediation and/or monitoring will be required. Second, the soil excavation will be conducted in July, which coincides with the dry season for MCB Camp Pendleton (albeit perhaps not the driest period of the year). Available groundwater elevation data for the site suggests that the groundwater table will most likely occur at or below the maximum anticipated depth of excavation during this time (see the cross section COC concentration isopleth maps that are attached). Due to the urgency of this removal action, the Navy is reluctant to delay the removal action past July. Therefore, if the PECS data show that it will be necessary excavate soil below the water table in order to achieve the RAOs, appropriate measures will be implemented during the removal action to deal with wet soil. These measures may include, for example: • Using appropriate excavating equipment for saturated soil; • Using temporary shoring to isolate and aid removal of localized "hot spots" that extend below the water table; • Implementing appropriate protective measures for dealing with wet soil, for example: using an impermeable material (e.g., polyethylene) to collect/control runoff from stockpiled soil so that it can be removed; and, using special containers	

NO.	SECTION	PAGE	COMMENT	RESPONSE	REVISION
				suitable for hauling water/wet soil; • Removing water that enters the excavation and collecting the pumped water in appropriate containers for disposal. Appropriate measures are described in the RAWP. Although not anticipated, if more drastic measures (e.g., dewatering) are required to accomplish the excavation, the Navy may choose to postpone the excavation until the water table drops to a level that would permit excavation to proceed without dewatering.	

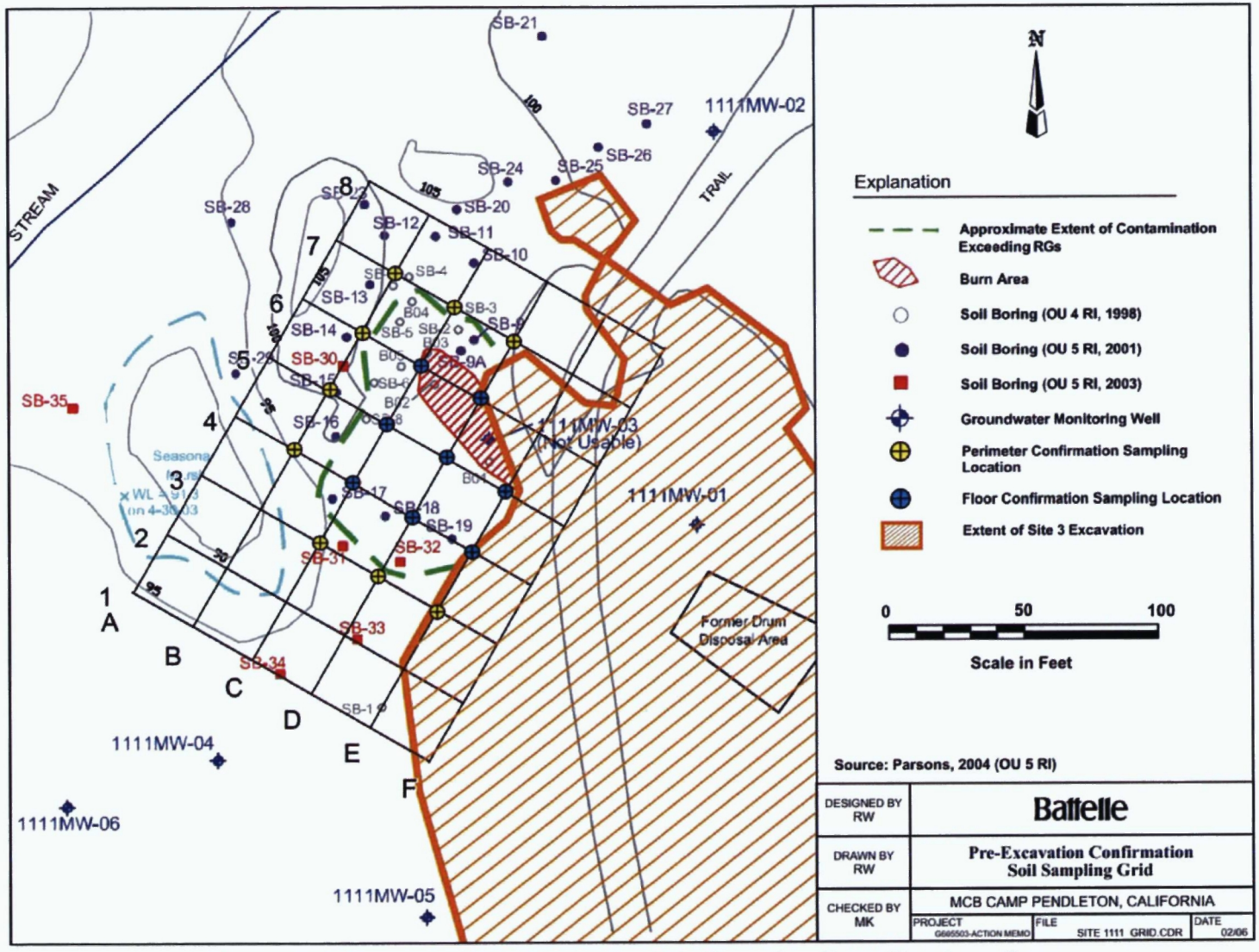


Figure C-1. Proposed Pre-Excavation Confirmation Sampling Locations

Table C-1. Proposed PECS Sampling Depths

PECS ID	PECS Location			Predicted Maximum Depth of Contamination Above RGs [a] (ft amsl)	Predicted Maximum Depth of Contamination Above RGs [a] (ft bgs)	Surface Sample	Target Sample Depth	
	Easting	Northing	Ground Surface Elevation (ft amsl)				Upper Interval (ft bgs)	Lower Interval (ft bgs)
Floor Sampling Locations								
C4	6231346.6	2062106	96.44	NA		NS	3 - 5 [b]	5 - 7
C5	6231359.2	2062128	98.86	NA		NS	3 - 5 [c]	5 - 7
C6	6231371.8	2062150	97.42	91.4	6.02	NS	7 - 9	9 - 11
D4	6231367.6	2062093	97.19	93.2	3.99	NS	5 - 7	7 - 9
D5	6231380.2	2062115	97.93	91.9	6.03	NS	7 - 9	9 - 11
D6	6231392.8	2062137	97.16	92.2	4.96	NS	6 - 8	8 - 10
E4	6231389.6	2062080	96.61	91.6	5.01	NS	6 - 8	8 - 10
E5	6231402.2	2062102	97.27	91.3	5.97	NS	7 - 9	9 - 11
Perimeter Sampling Locations								
B4	6231325.0	2062118	95.78	NA		0 - 2	3 - 5 [b]	5 - 7
B5	6231337.6	2062140	98.92	NA		0 - 2	3 - 5 [c]	5 -7
B6	6231350.2	2062162	98.77	NA		0 - 2	3 - 5 [d]	5 - 7
B7	6231362.8	2062184	97.99	NA		0 - 2	5 - 7 [e]	7 - 9
C3	6231334.0	2062084	95.95	NA		0 - 2	3 - 5 [b]	5 - 7
C7	6231384.4	2062172	95.48	NA		0 - 2	5 - 7 [e]	7 - 9
D3	6231355.0	2062071	96.14	NA		0 - 2	2 - 4 [f]	5 - 7
D7	6231405.4	2062159	93.51	NA		0 - 2	5 - 7 [e]	7 - 9
E3	6231377.0	2062058	96.22	NA		0 - 2	2 - 4 [f]	5 - 7

NA. Contamination above RGs is not predicted to occur at any depth at this location based on COC concentration isopleths. Target sample depths these locations are based on concentrations in adjacent soil borings.

NS. Not Sampled (surface samples will be collected for perimeter samples only).

a. Predicted elevation/depth of deepest point at this location that exceeds RGs; Based on concentration isopleths for soil COCs at Site 1111.

b. Based on pesticides detected in 1111SB-17 from 0-1 ft bgs.

c. Based on pesticides detected in 1111SB-8 from 1-1.5 ft bgs.

d. Based on pesticides detected in 1111SB-5 from 1-1.5 ft bgs.

e. Based on volatile organic compounds (VOCs) detected in 1111SB-9 as deep as 6 ft bgs.

f. Based on pesticides detected in 1111SB-32 from 2-4 ft bgs.

Table C-2. Comparison of Maximum Detected Concentrations in Groundwater (2001-2003) vs Surface Water Criteria Protective of Ecological Receptors

Chemical	National Ambient Water Quality Criteria [a]	Number of Samples	Number of Detections	Well ID (Source of Maximum Concentration)	Max Concentration
VOCs (ug/L)					
1,2,4-TMB	NE	11	4	1111MW-1	1
1,2-DCA	NE	11	2	1111MW-1	1
2-Butanone (MEK)	NE	11	1	1111MW-1	2 J
Acetone	NE	11	1	1111MW-1	4 J
Benzene	NE	11	6	1111MW-1	18.1
Ethylbenzene	NE	11	4	1111MW-1	2.1
m,p-Xylenes	NE	11	8	1111MW-1	7.9
Naphthalene	NE	11	1	1111MW-1	0.4 J1
o-Xylene	NE	11	4	1111MW-1	3.9
PCE	NE	11	6	1111MW-5	5.4
TCE	NE	11	4	1111MW-5	1.5
Toluene	NE	11	6	1111MW-1	31.6
SVOCs (ug/L)					
2,6-Dinitrotoluene	NE	8	1	1111MW-2	15 [e]
Pesticides and Herbicides (ug/L)					
DDD	NE	8	1	1111MW-4	0.02 J1
Metals (ug/L)					
Aluminum	NE	8	4	1111MW-6	570
Antimony	30	8	1	1111MW-4	3.5
Arsenic	190	8	6	1111MW-5	6.6
Barium	NE	8	8	1111MW-6	97
Chromium	11	8	7	3W-35B	27
Iron	NE	8	7	1111MW-6	4400
Manganese	NE	8	8	3W-35B	490
Mercury	0.012	8	3	1111MW-4	0.31
Nickel	73	8	1	3W-35B	12
Selenium	NE	8	2	1111MW-2	4.2
Vanadium	NE	8	1	1111MW-6	8.7
Zinc	NE	8	7	3W-35A	25

Maximum concentration exceeds the National Ambient WQC.

note: No Dioxin cogeners were detected in groundwater during 2001-2003 groundwater sampling.

(a) Compilation of criteria found in: U.S. EPA. 1986. Quality Criteria for Water., U.S. EPA. 1989. Ambient Water Quality Criteria, Vol. 1980, 1984, 1986, 1987, and 1989., U.S. EPA. 1976. Quality Criteria for Water., and U.S. EPA. 1972. Water Quality Criteria.

These criteria were initially published by the U.S. EPA under the federal Clean Water Act to protect human health and welfare and freshwater and marine aquatic life. These criteria were adopted by the San Diego RWQCB (RWQCB. 1994. Water Quality Control Plan for the San Diego Basin. September, 8.)

(b) Detected only once in a duplicate sample.

J - Estimated value

J1 - Detected concentration is below the RL but above the MDL.

NE - not established

Table C-3. Comparison of Maximum Detected Concentrations in Groundwater (1998) vs Surface Water Criteria Protective of Ecological Receptors

Chemical	National Ambient Water Quality Criteria [a]	Number of Samples	Number of Detections	Well ID (Source of Maximum Concentration)	Max Concentration
VOCs (ug/L)					
Naphthalene	NE	4	1	1111MW-01	3.9
PCE	NE	4	3	1111MW-03	24
SVOCs (ug/L)					
bis(2-Ethylhexyl)phthalate	NE	4	1	1111MW-01	350
Pesticides and Herbicides (ug/L)					
DDD	NE	4	1	1111MW-03	0.03 J1
DDE	NE	4	2	1111MW-03	0.08 J1
DDT	NE	4	2	1111MW-03	0.04 J1
Metals (ug/L)					
Aluminum	NE	4	1	1111MW-02	38 J1
Antimony	30	4	2	1111MW-03	4.4 J1
Arsenic	190	4	4	1111MW-01	7.7 J1
Barium	NE	4	3	1111MW-01	70.9
Chromium	11	4	2	1111MW-03	1.6 J1
Iron	NE	4	4	1111MW-02	1210
Manganese	NE	4	4	1111MW-01	339
Mercury	0.012	4	1	1111MW-03	0.24
Nickel	73	4	3	1111MW-02/ 1111MW-03	1.8 J1/ 1.8 J1
Thallium	NE	4	1	1111MW-03	3 J1
Vanadium	NE	4	2	1111MW-03	4.4 J1
Zinc	NE	4	2	1111MW-03	18.8 J1
Dioxin/Furans (pg/L)					
OCDD	NE	4	4	1111MW-03	18.1 J
OCDF	NE	4	2	1111MW-01	16.1 J
TCDD	NE	4	1	1111MW-01	2.4 J
HPCDD	NE	4	2	1111MW-01	4.2
HPCDF	NE	4	1	1111MW-01	6.6
HXCDD	NE	4	1	1111MW-01	7.8
HXCDF	NE	4	3	1111MW-01	9.8
PECDD	NE	4	1	1111MW-01	1.5
PECDF	NE	4	1	111-MW-01	4.6 J

Maximum concentration exceeds the National Ambient WQC.

(a) Compilation of criteria found in: U.S. EPA. 1986. Quality Criteria for Water., U.S. EPA. 1989. Ambient Water Quality Criteria, Vol. 1980, 1984, 1986, 1987, and 1989., U.S. EPA. 1976. Quality Criteria for Water., and U.S. EPA. 1972.

Water Quality Criteria.

These criteria were initially published by the U.S. EPA under the federal Clean Water Act to protect human health and welfare and freshwater and marine aquatic life. These criteria were adopted by the San Diego RWQCB (RWQCB. 1994. Water Quality Control Plan for the San Diego Basin. September, 8.)

(b) Detected only once in a duplicate sample.

J - Estimated value

J1 - Detected concentration is below the RL but above the MDL.

NE - not established

Table C-4. Removal Goals for Site 1111 Soil COCs

Contaminant of Concern	Maximum Concentration	Background Concentration [a] 0 to 5 ft	Removal Goals		
			Human Health RGs [b]	Ecological RGs [c]	RGs Protective of Groundwater [d]
Dioxins/Furans (pg/g)					
2,3,7,8-TCDD TEQ	42,308	–	3.9	44	–
Volatile Organic Compounds (µg/kg)					
1,2,4-TMB	220,000	–	94,489.22	–	575
1,3,5-TMB	70,800	–	–	–	420
cis-1,2-DCE	840	–	–	–	50
Methylene chloride	1,200	–	–	–	33
Naphthalene	40,600	–	–	–	400
PCE	980	–	805.14	–	200
TCE	11,500	–	7,984.21	–	72
Semivolatile Organic Compounds (µg/kg)					
Benzo(a)anthracene	260	–	–	–	200
Hexachlorobenzene	1,800	–	270.18	650	115
Pesticides (µg/kg)					
4,4'-DDD	44,500	–	2026.31	–	2,450
4,4'-DDE	43,000	–	1430.34	–	2,450
4,4'-DDT	17,000	–	1719.87	–	2,450
Inorganics (mg/kg)					
Antimony	3,210	8.8	31.29	12	–
Arsenic	72	4.6	1.8	–	–
Cadmium	9	1.6	1.67	–	–
Chromium (VI)	28	–	16.29	–	–
Copper	34,100	26.8	3128.57	–	–
Lead	19,300	29.1	150 [e]	–	–
Manganese	2,770	688	1812.16	–	–
Mercury	3,650	0.08	23.46	8.5	–

(a) Santa Margarita Background (SWDIV, 1997).
(b) The value selected is the more stringent of the Cal-EPA- and U.S.EPA-modified preliminary removal goals (PRGs).
(c) The value, selected as a site- and chemical-specific ecological PRG, is the lowest of the ecological PRGs for any wildlife receptor.
(d) The value was calculated using VLEACH/SUMMERS model.
(e) The value is the U.S. EPA Region 9 Residential PRG for lead.
– Indicates that constituent was not identified as a COC during that specific risk assessment.
Source: modified from Parsons (2005).

Table C-5. Proposed Analyses for Confirmation Samples

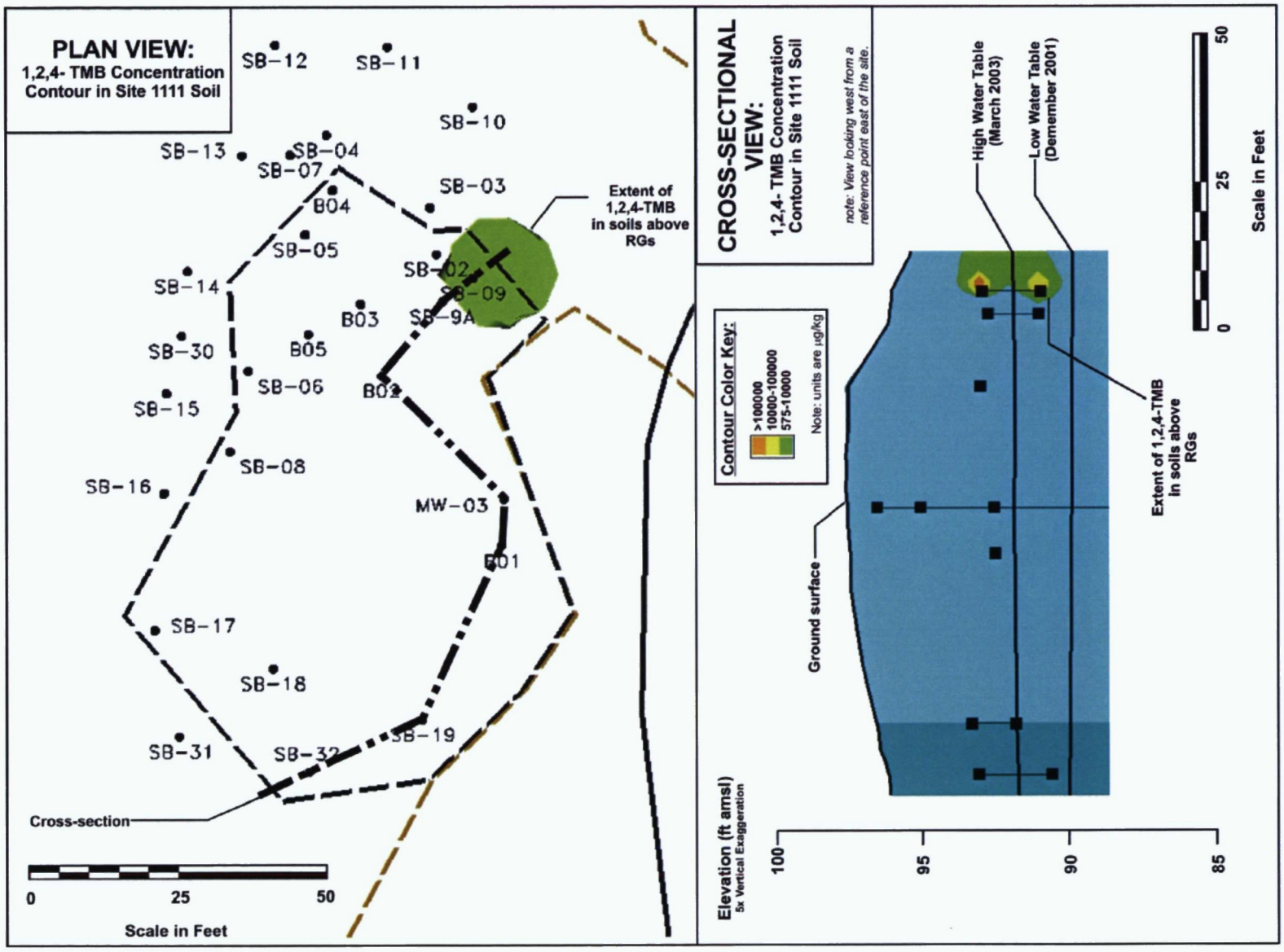
Chemical Type	Sample Matrix	Analytical Method
VOCs	Soil	U.S. EPA SW-846 5035/8260B
SVOCs	Soil	U.S. EPA SW-846 3545/8270C LVI-GC/MS
Pesticides	Soil	U.S. EPA SW-846 8081A/8082
Metals	Soil	U.S. EPA SW-846 6020/7470
Dioxins	Soil	U.S. EPA SW-846 8290

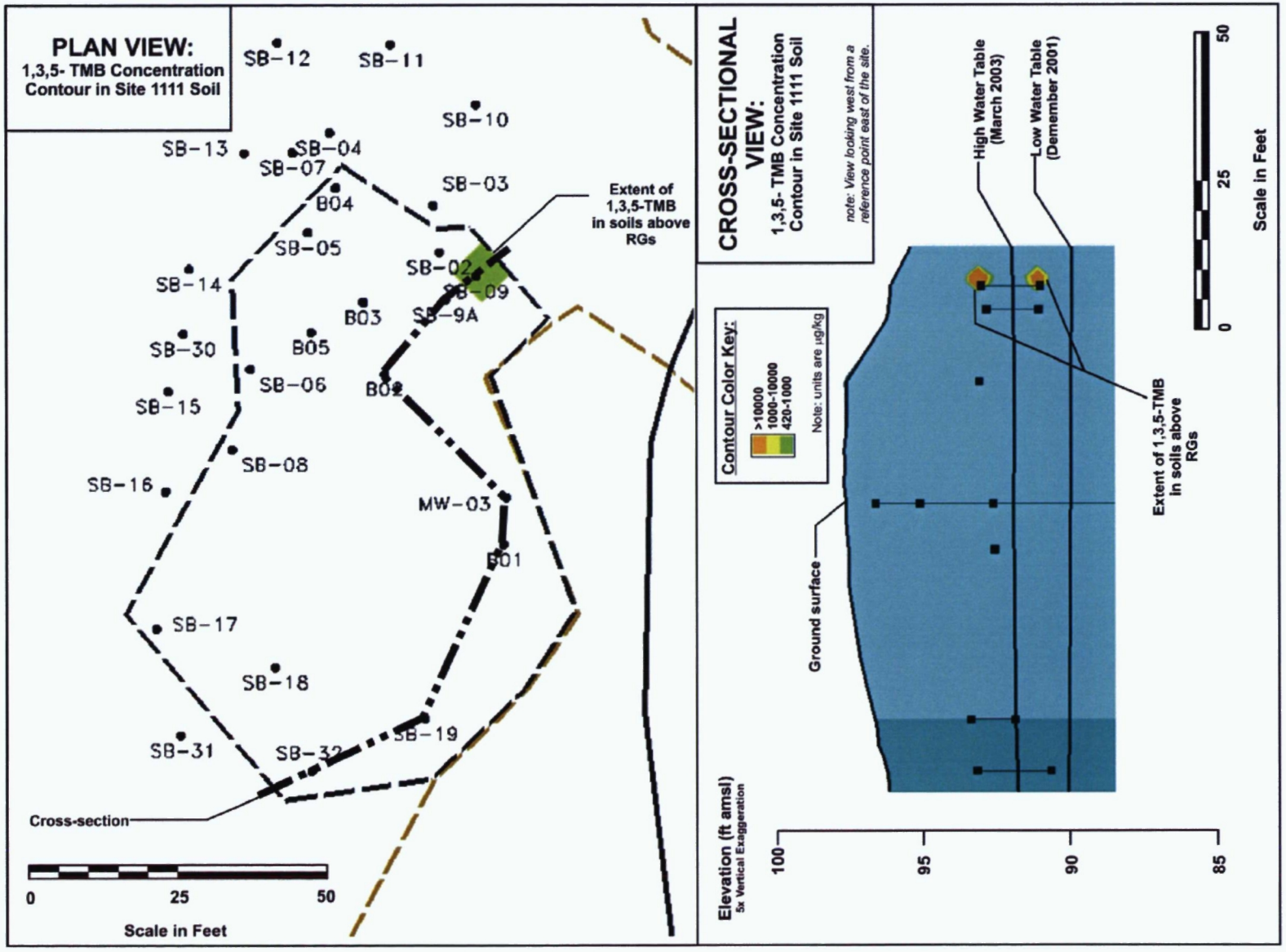
Note: Except for SVOCs and Dioxins, only COCs within each group of chemicals will be analyzed/reported. All SVOCs and Dioxins that are measured with the listed methods will be reported.

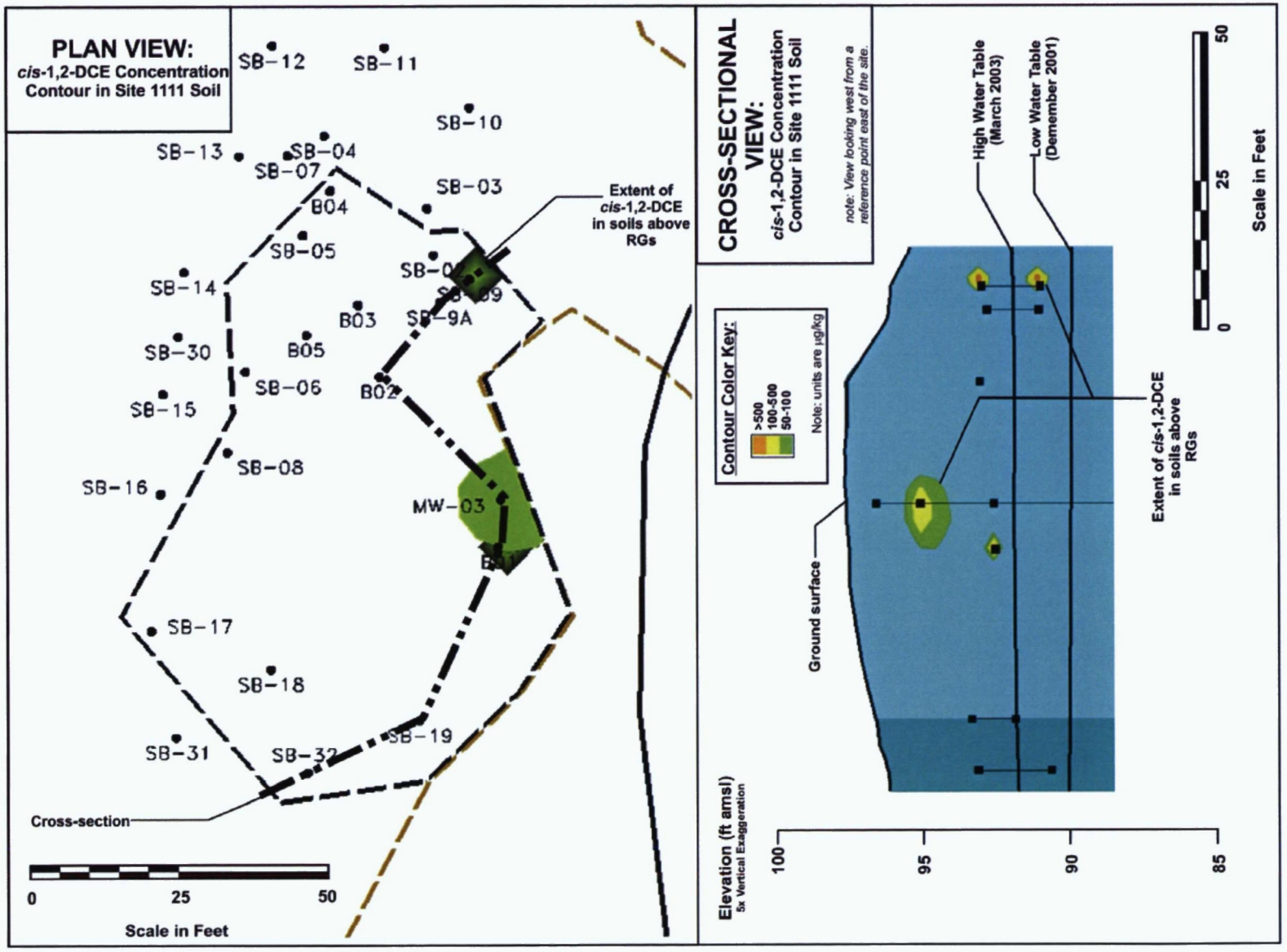
Table C-6. Analytes, Hazardous Waste Criteria, and Analytical Methods Proposed for Stockpile Samples

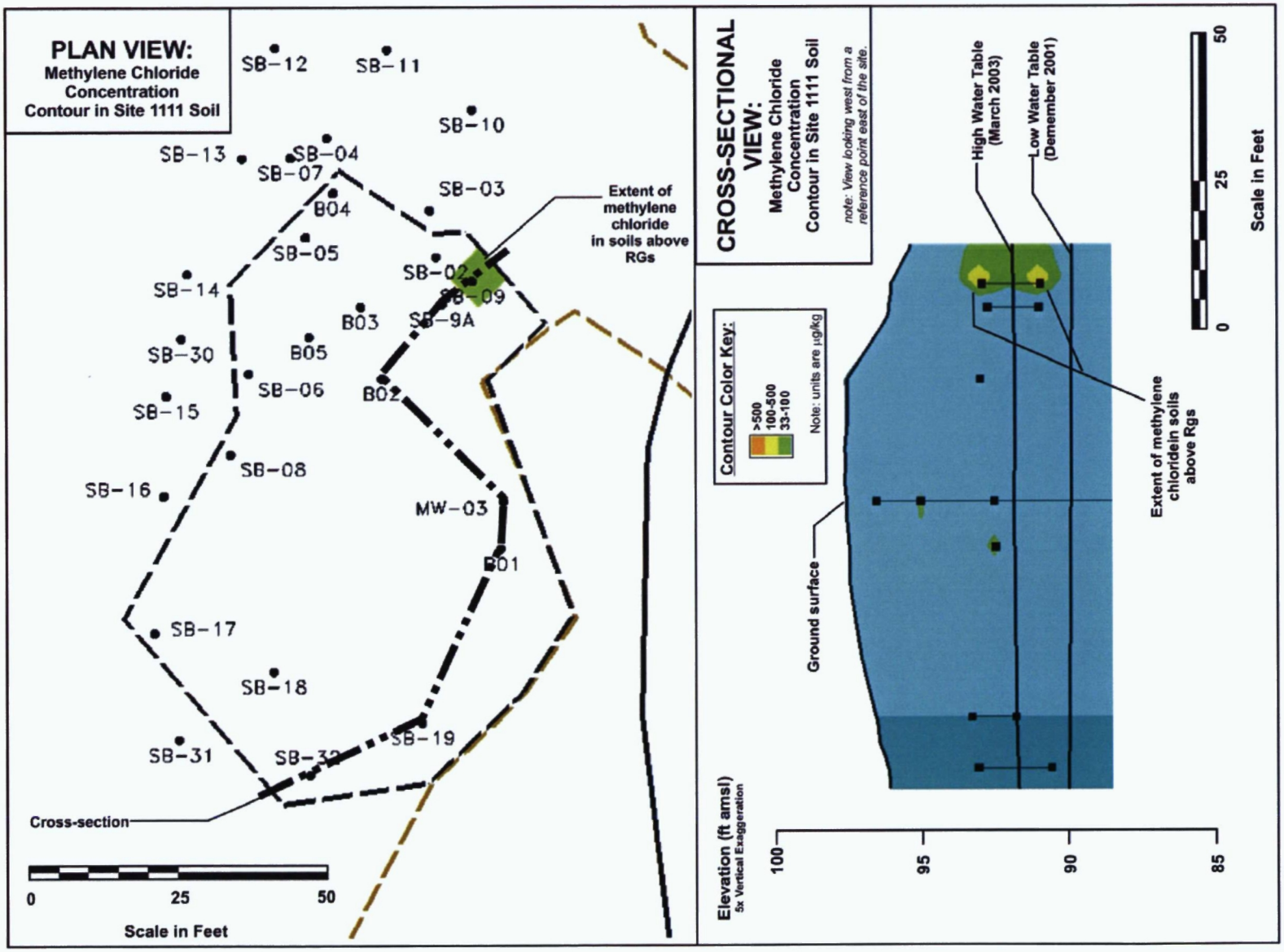
Chemical	California-Hazardous Criteria		RCRA-Hazardous Criteria
	TTLC (mg/kg)	STLC (mg/L)	TCLP (mg/L)
4,4'-DDD	1	0.1	---
4,4'-DDE	1	0.1	---
4,4'-DDT	1	0.1	---
Antimony	500	15	---
Arsenic	500	5	5
Barium	10,000	100	100
Chromium	500	5	5
Copper	2,500	25	---
Lead	1,000	5	5
Mercury	20	0.2	0.2
TCE	2,040	204	0.5
Zinc	5,000	250	---

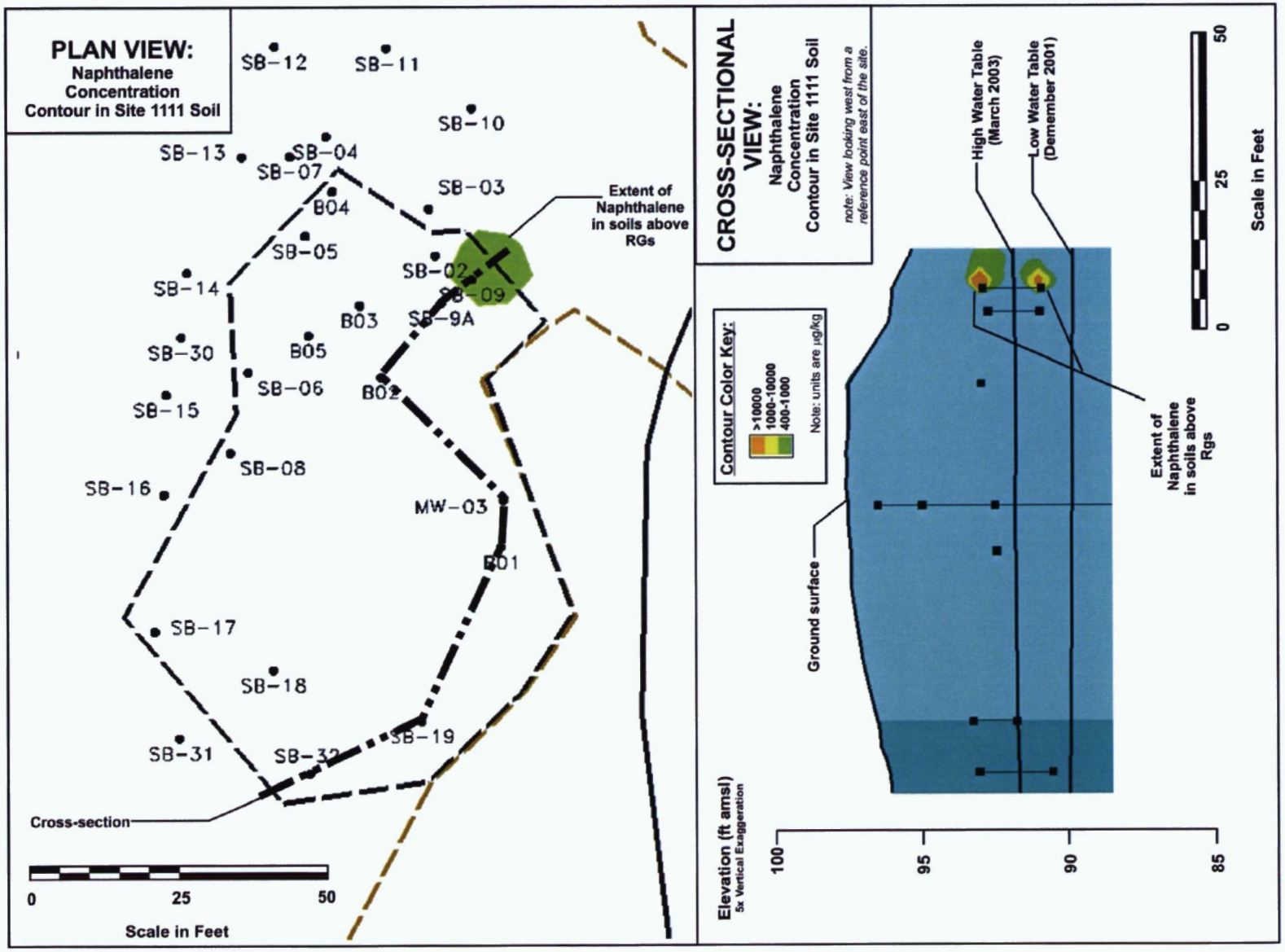
SOIL CONCENTRATION ISOPLETH MAPS
FOR SELECTED SITE 1111 COCs

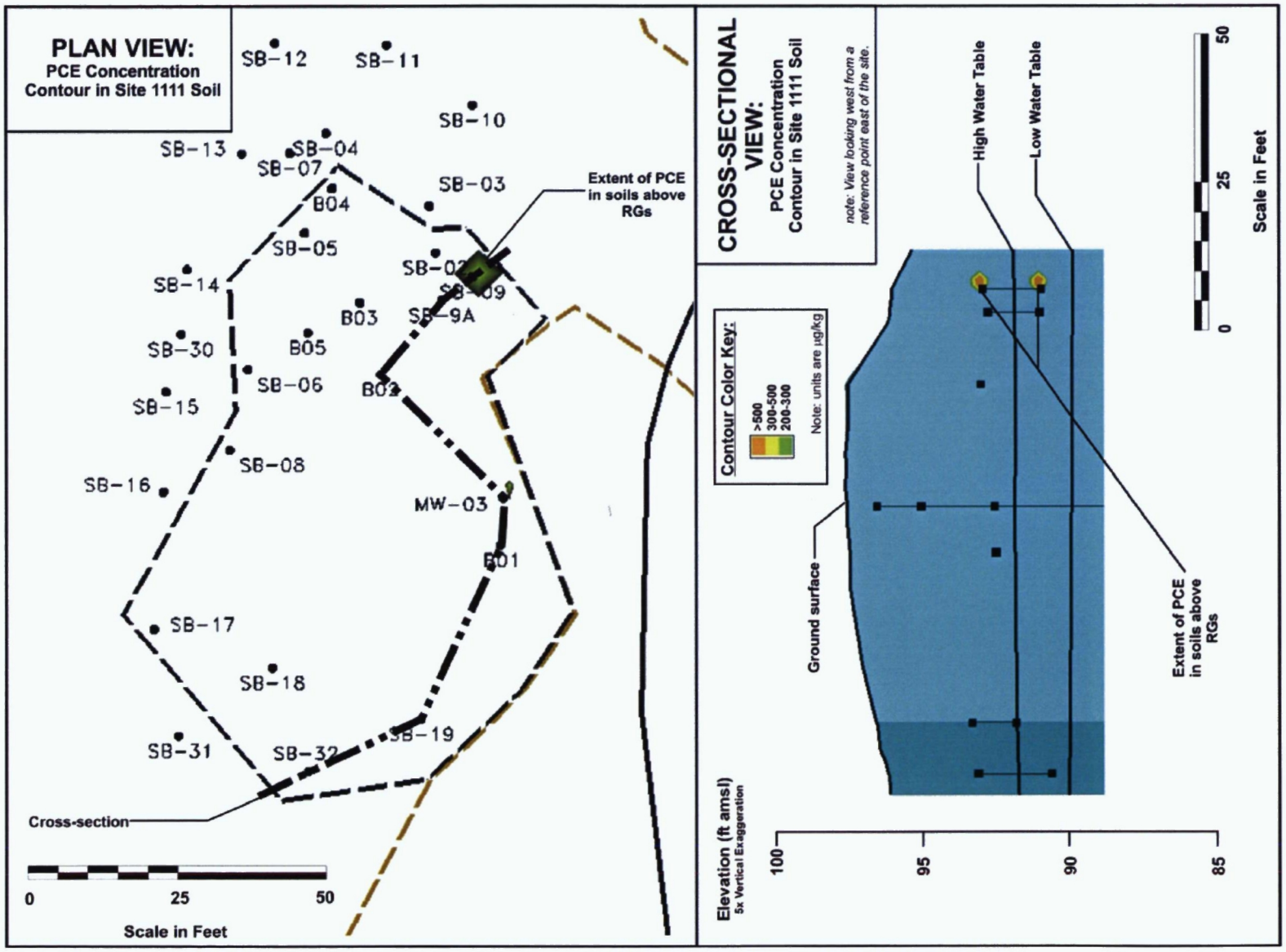

PLAN VIEW:
1,2,4- TMB Concentration Contour in Site 1111 Soil
SB-12
SB-11
SB-10
SB-13
SB-04
SB-07
SB-03
B04
Extent of 1,2,4-TMB in soils above RGs
SB-05
SB-02
SB-14
SB-09
B03
SB-9A
SB-30
B05
SB-06
B02
SB-15
SB-08
SB-16
MW-03
B01
SB-17
SB-18
SB-31
SB-32
SB-19
Cross-section
0
25
50
Scale in Feet
CROSS-SECTIONAL VIEW:
1,2,4- TMB Concentration Contour in Site 1111 Soil
note: View looking west from a reference point east of the site.
Contour Color Key:
>100000
10000-100000
575-10000
Note: units are µg/kg
High Water Table (March 2003)
Low Water Table (Demember 2001)
Extent of 1,2,4-TMB in soils above RGs
Ground surface
Elevation (ft amsl)
5x Vertical Exaggeration
100
95
90
85
0
25
50
Scale in Feet

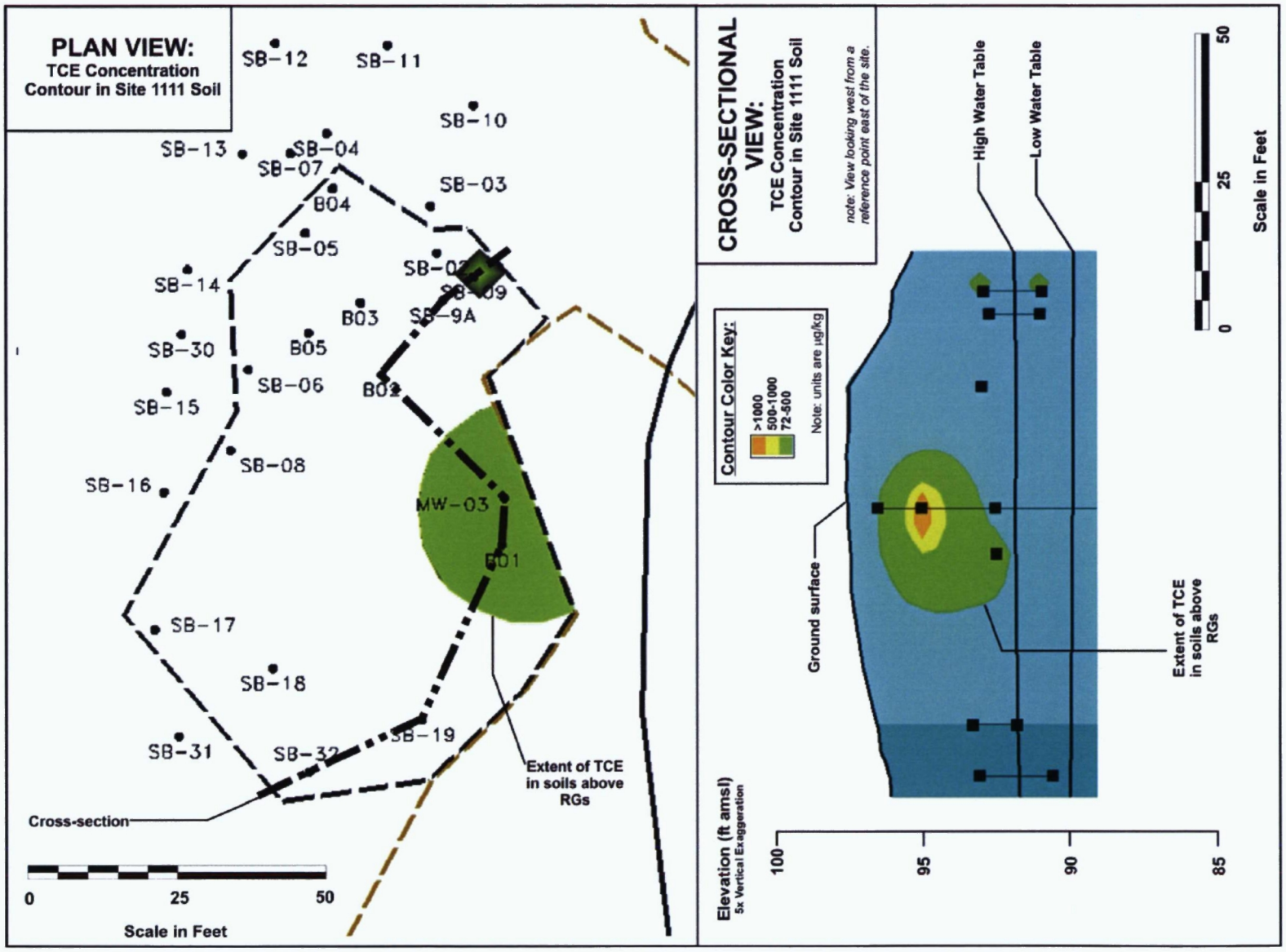

PLAN VIEW:
1,3,5- TMB Concentration Contour in Site 1111 Soil
SB-12
SB-11
SB-10
SB-13
SB-04
SB-07
SB-03
B04
SB-05
SB-02
SB-09
SB-14
B03
SB-9A
SB-30
B05
SB-06
B02
SB-15
SB-08
SB-16
MW-03
B01
SB-17
SB-18
SB-31
SB-32
SB-19
Extent of 1,3,5-TMB in soils above RGs
Cross-section
0
25
50
Scale in Feet
CROSS-SECTIONAL VIEW:
1,3,5- TMB Concentration Contour in Site 1111 Soil
note: View looking west from a reference point east of the site.
Contour Color Key:
>10000
1000-10000
420-1000
Note: units are µg/kg
High Water Table (March 2003)
Low Water Table (Demember 2001)
Extent of 1,3,5-TMB in soils above RGs
Ground surface
Elevation (ft amsl)
5x Vertical Exaggeration
100
95
90
85
0
25
50
Scale in Feet

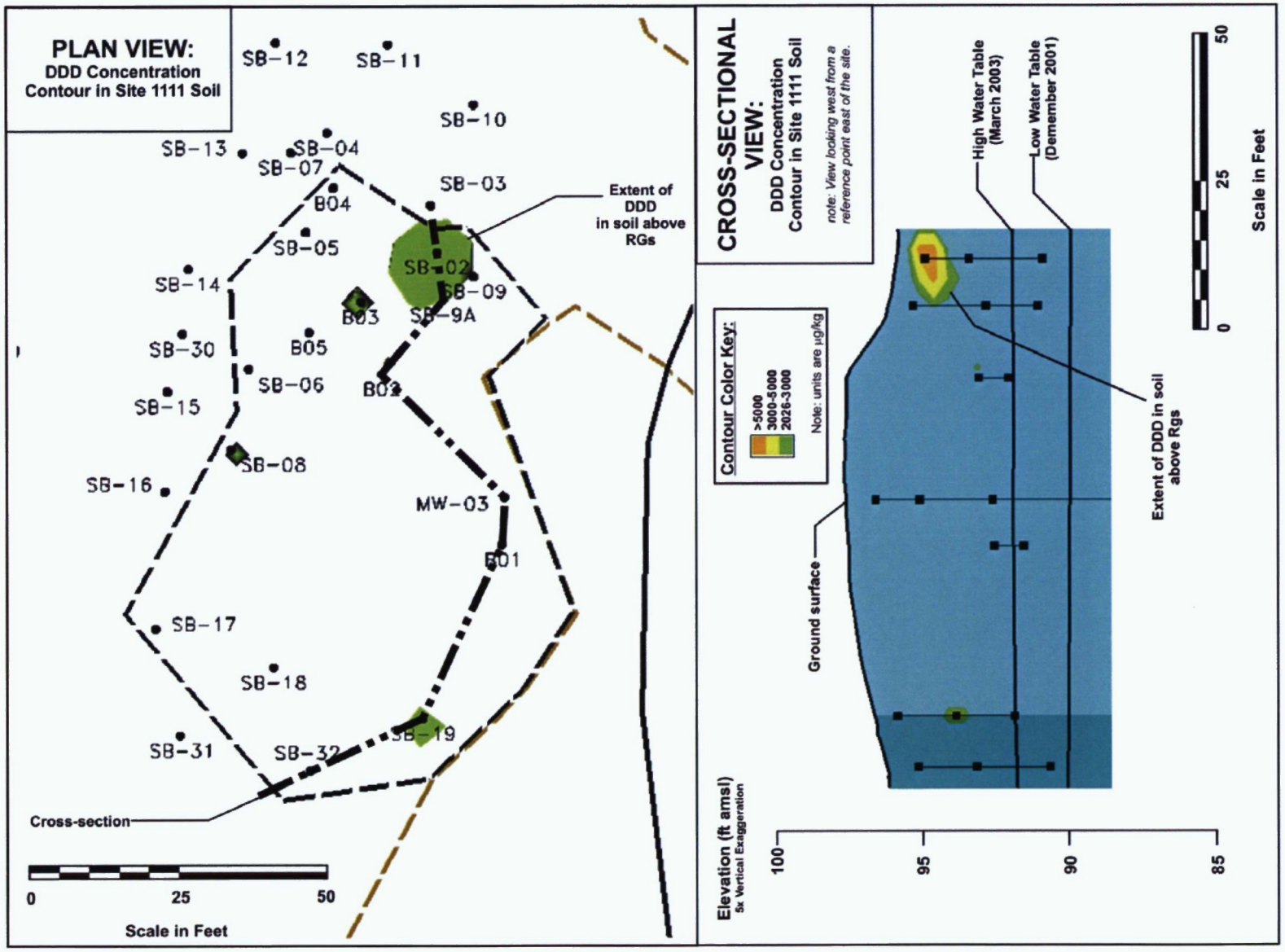

PLAN VIEW:
cis-1,2-DCE Concentration Contour in Site 1111 Soil
SB-12
SB-11
SB-10
SB-13
SB-04
SB-07
SB-03
B04
SB-05
SB-14
B03
SB-9A
SB-30
B05
SB-06
B02
SB-15
SB-08
SB-16
MW-03
SB-17
SB-18
SB-31
SB-32
SB-19
Extent of cis-1,2-DCE in soils above RGs
Cross-section
0
25
50
Scale in Feet
CROSS-SECTIONAL VIEW:
cis-1,2-DCE Concentration Contour in Site 1111 Soil
note: View looking west from a reference point east of the site.
Contour Color Key:
>500
100-500
50-100
Note: units are µg/kg
High Water Table (March 2003)
Low Water Table (Demember 2001)
Extent of cis-1,2-DCE in soils above RGs
Ground surface
Elevation (ft amsl)
5x Vertical Exaggeration
100
95
90
85
0
25
50
Scale in Feet

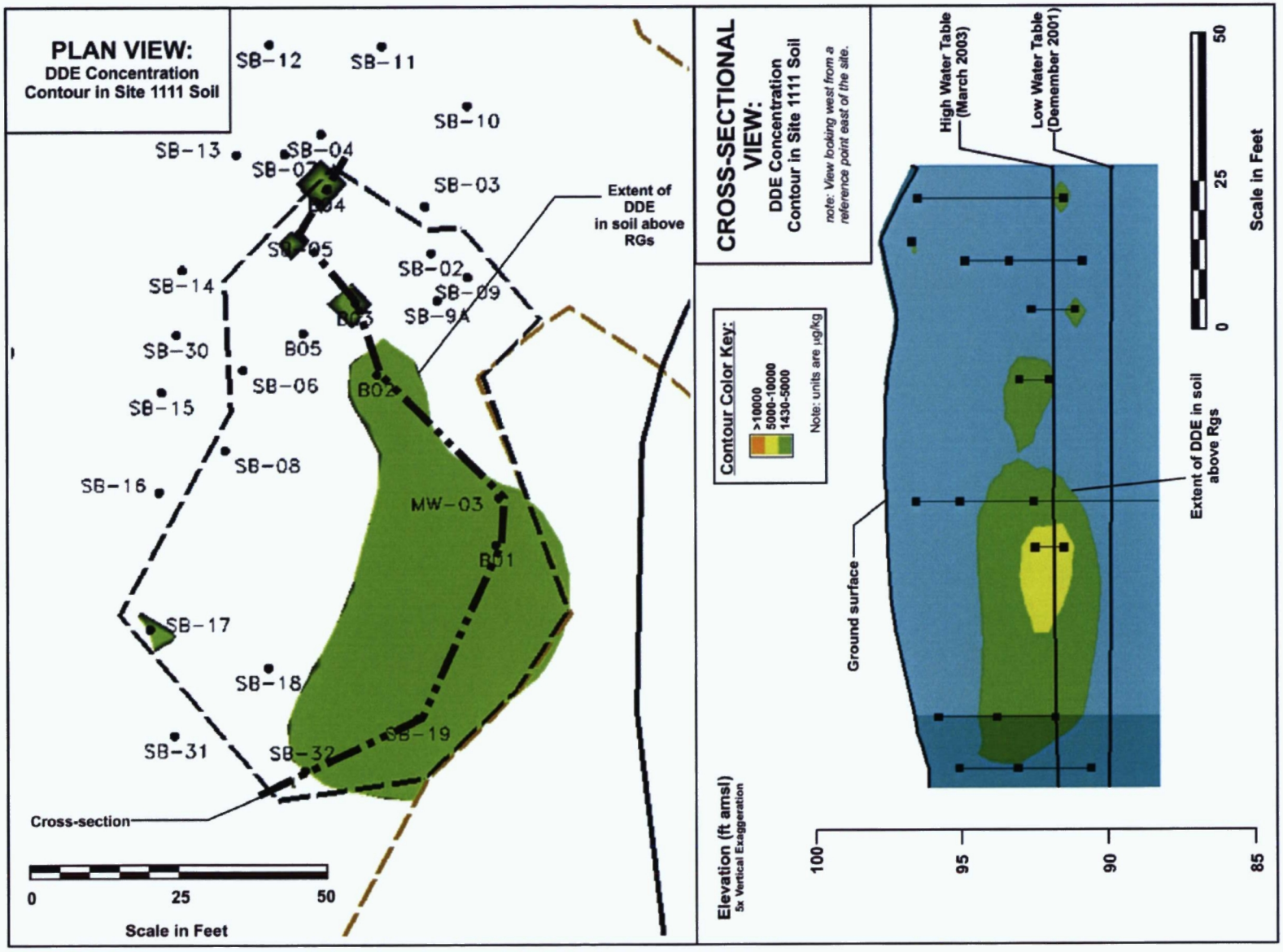

PLAN VIEW:
Methylene Chloride Concentration Contour in Site 1111 Soil
SB-12
SB-11
SB-10
SB-13
SB-04
SB-07
SB-03
B04
SB-05
SB-02
SB-09
SB-14
B03
SB-9A
SB-30
B05
SB-06
B02
SB-15
SB-08
SB-16
MW-03
B01
SB-17
SB-18
SB-19
SB-31
SB-32
Extent of methylene chloride in soils above RGs
Cross-section
0
25
50
Scale in Feet
CROSS-SECTIONAL VIEW:
Methylene Chloride Concentration Contour in Site 1111 Soil
note: View looking west from a reference point east of the site.
Contour Color Key:
>500
100-500
33-100
Note: units are µg/kg
High Water Table (March 2003)
Low Water Table (Demember 2001)
Extent of methylene chloridein soils above Rgs
Ground surface
Elevation (ft amsl)
5x Vertical Exaggeration
100
95
90
85
0
25
50
Scale in Feet

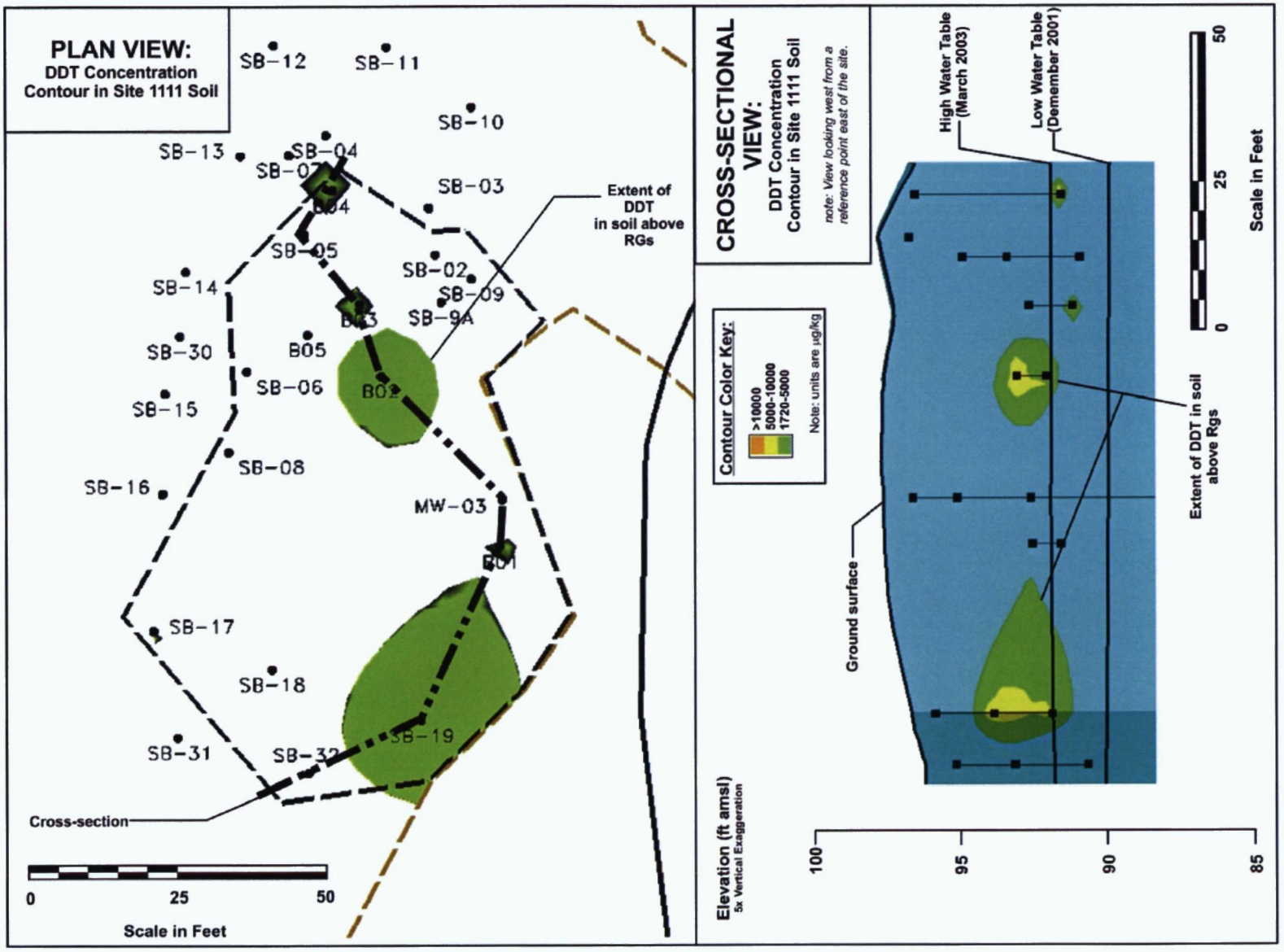

PLAN VIEW:
Naphthalene Concentration Contour in Site 1111 Soil
SB-12
SB-11
SB-10
SB-13
SB-04
SB-07
SB-03
B04
Extent of Naphthalene in soils above RGs
SB-05
SB-02
SB-14
SB-09
B03
SB-9A
SB-30
B05
SB-06
B02
SB-15
SB-08
SB-16
MW-03
B01
SB-17
SB-18
SB-19
SB-31
SB-32
Cross-section
0
25
50
Scale in Feet
CROSS-SECTIONAL VIEW:
Naphthalene Concentration Contour in Site 1111 Soil
note: View looking west from a reference point east of the site.
Contour Color Key:
>10000
1000-10000
400-1000
Note: units are µg/kg
High Water Table (March 2003)
Low Water Table (Demember 2001)
Extent of Naphthalene in soils above Rgs
Ground surface
Elevation (ft amsl)
5x Vertical Exaggeration
100
95
90
85
0
25
50
Scale in Feet

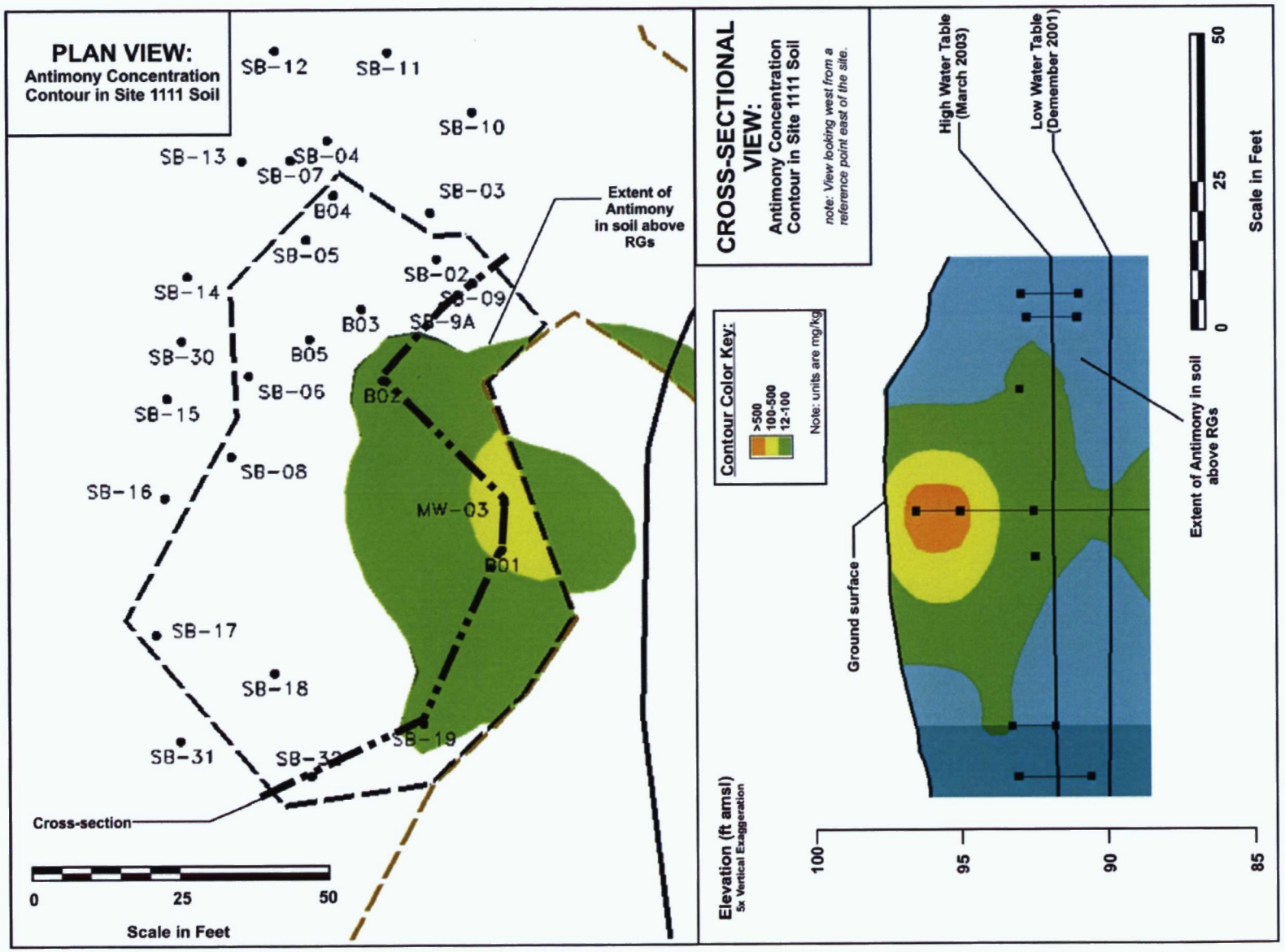

PLAN VIEW:
PCE Concentration
Contour in Site 1111 Soil
SB-12
SB-11
SB-10
SB-13
SB-04
SB-07
SB-03
B04
SB-05
SB-02
SB-14
SB-09
B03
SB-9A
SB-30
B05
SB-06
B02
SB-15
SB-08
SB-16
MW-03
B01
SB-17
SB-18
SB-31
SB-32
SB-19
Extent of PCE in soils above RGs
Cross-section
0
25
50
Scale in Feet
CROSS-SECTIONAL VIEW:
PCE Concentration
Contour in Site 1111 Soil
note: View looking west from a reference point east of the site.
Contour Color Key:
>500
300-500
200-300
Note: units are µg/kg
High Water Table
Low Water Table
Ground surface
Extent of PCE in soils above RGs
Elevation (ft amsl)
5x Vertical Exaggeration
100
95
90
85
0
25
50
Scale in Feet

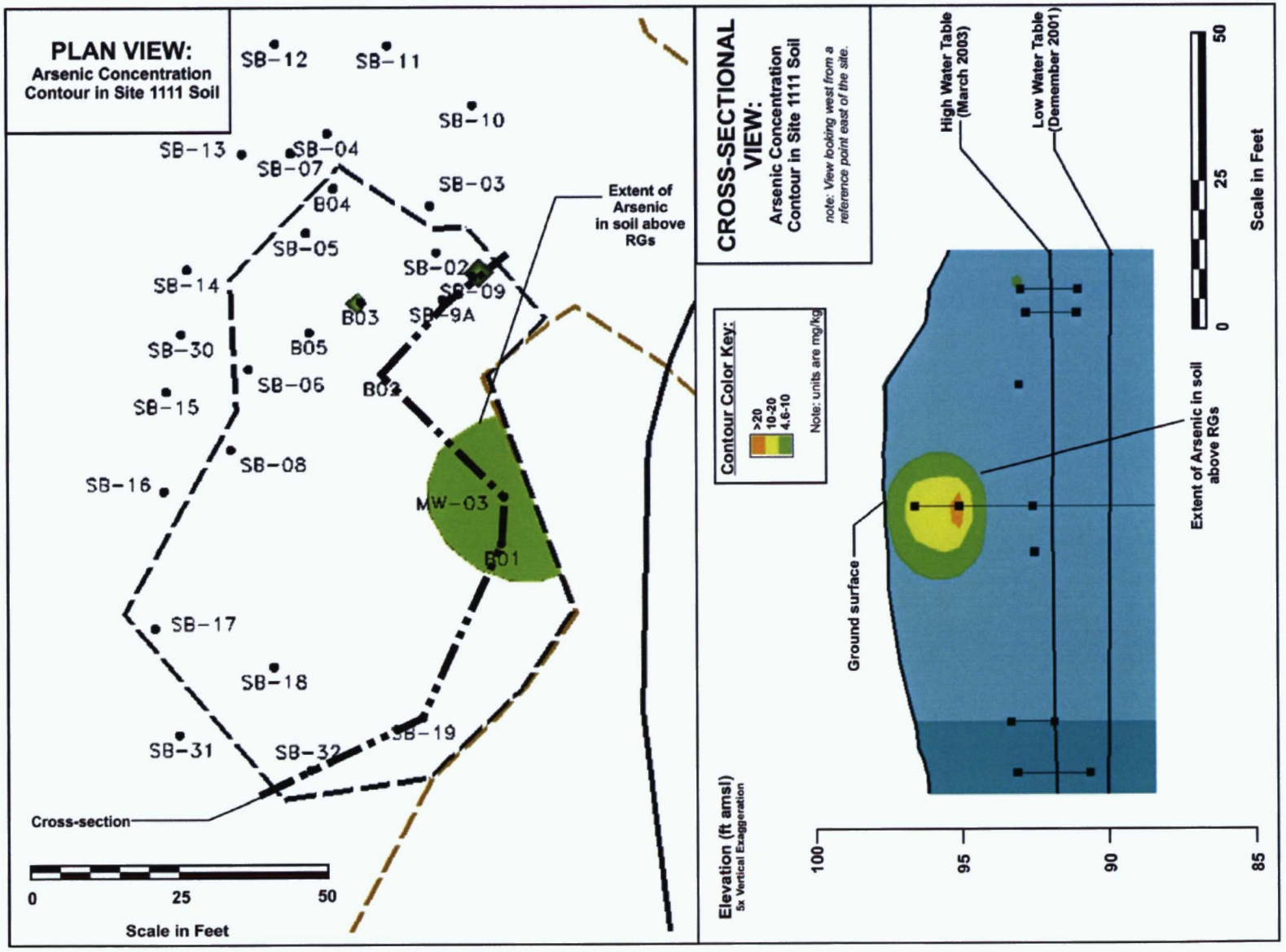

PLAN VIEW:
TCE Concentration
Contour in Site 1111 Soil
SB-12
SB-11
SB-10
SB-13
SB-04
SB-07
SB-03
B04
SB-05
SB-14
B03
SB-9A
SB-30
B05
SB-06
B02
SB-15
SB-08
SB-16
MW-03
B01
SB-17
SB-18
SB-31
SB-32
SB-19
Extent of TCE
in soils above
RGs
Cross-section
0
25
50
Scale in Feet
CROSS-SECTIONAL
VIEW:
TCE Concentration
Contour in Site 1111 Soil
note: View looking west from a
reference point east of the site.
Contour Color Key:
>1000
500-1000
72-500
Note: units are µg/kg
High Water Table
Low Water Table
Ground surface
Extent of TCE
in soils above
RGs
Elevation (ft amsl)
5x Vertical Exaggeration
100
95
90
85
0
25
50
Scale in Feet

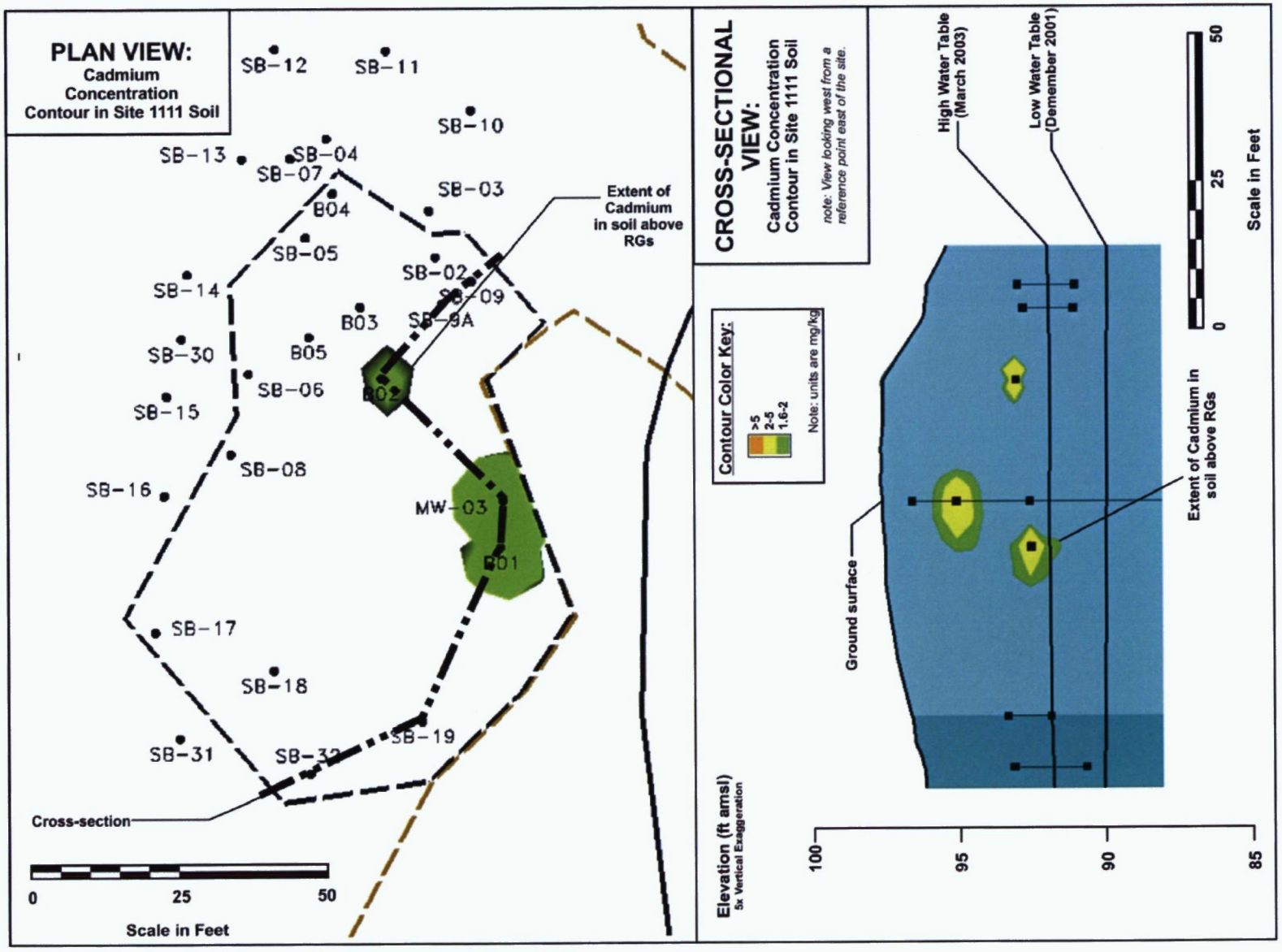

PLAN VIEW:
DDD Concentration
Contour in Site 1111 Soil
SB-12
SB-11
SB-10
SB-13
SB-04
SB-07
SB-03
B04
Extent of
DDD
in soil above
RGs
SB-05
SB-02
SB-14
SB-09
B03
SB-9A
SB-30
B05
SB-06
B02
SB-15
SB-08
SB-16
MW-03
B01
SB-17
SB-18
SB-19
SB-31
SB-32
Cross-section
0
25
50
Scale in Feet
CROSS-SECTIONAL VIEW:
DDD Concentration
Contour in Site 1111 Soil
note: View looking west from a reference point east of the site.
Contour Color Key:
>5000
3000-5000
2026-3000
Note: units are µg/kg
High Water Table
(March 2003)
Low Water Table
(Demember 2001)
Extent of DDD in soil
above Rgs
Ground surface
Elevation (ft amsl)
5x Vertical Exaggeration
100
95
90
85
0
25
50
Scale in Feet

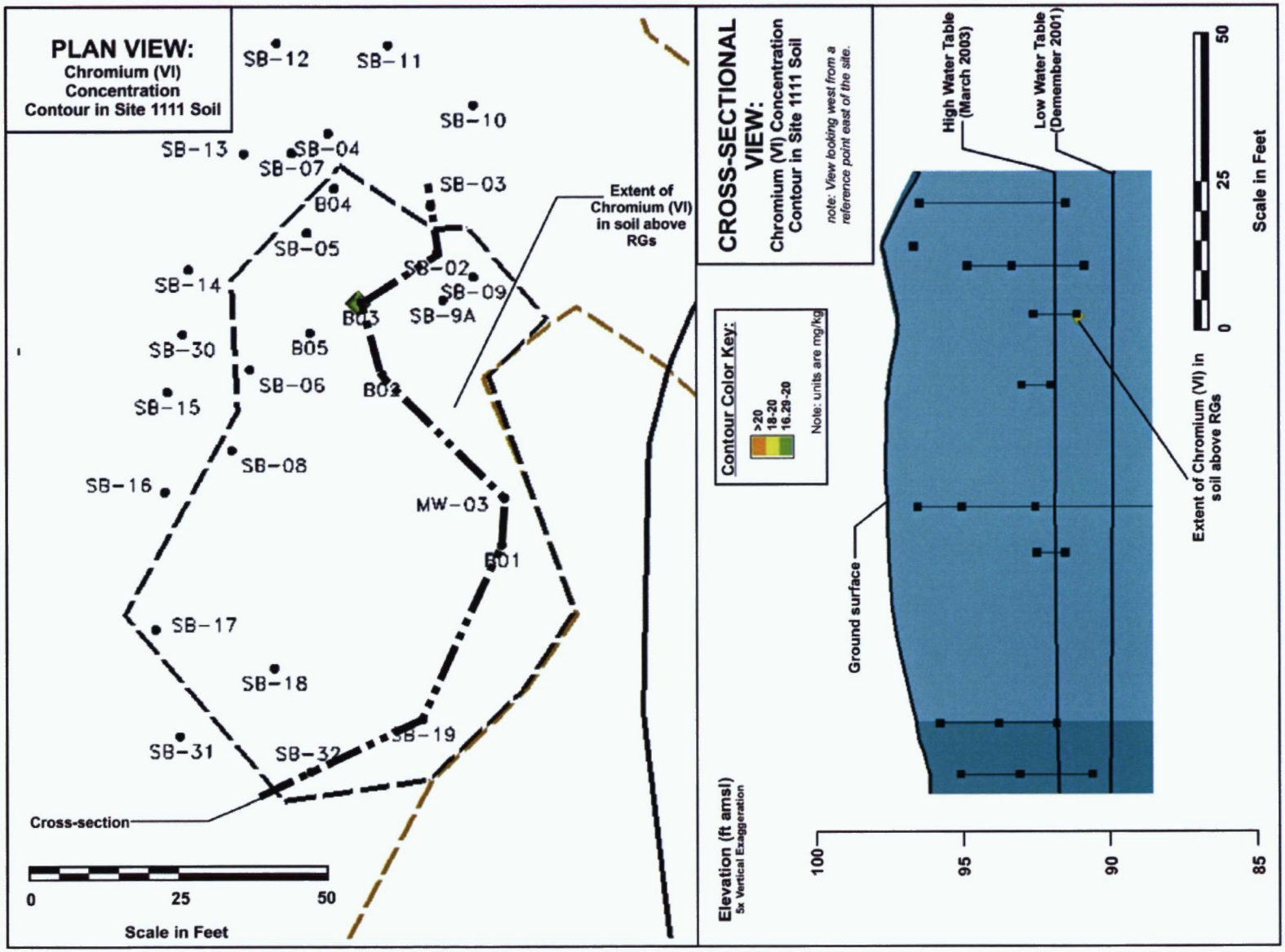

PLAN VIEW:
DDE Concentration
Contour in Site 1111 Soil
SB-12
SB-11
SB-10
SB-13
SB-04
SB-07
SB-03
B04
SB-05
SB-02
SB-14
SB-09
SB-9A
B03
SB-30
B05
SB-06
B02
SB-15
SB-08
SB-16
MW-03
B01
SB-17
SB-18
SB-19
SB-31
SB-32
Extent of DDE in soil above RGs
Cross-section
0
25
50
Scale in Feet
CROSS-SECTIONAL VIEW:
DDE Concentration
Contour in Site 1111 Soil
note: View looking west from a reference point east of the site.
Contour Color Key:
>10000
5000-10000
1430-5000
Note: units are µg/kg
High Water Table (March 2003)
Low Water Table (Demember 2001)
Ground surface
Extent of DDE in soil above Rgs
Elevation (ft amsl)
5x Vertical Exaggeration
100
95
90
85
0
25
50
Scale in Feet

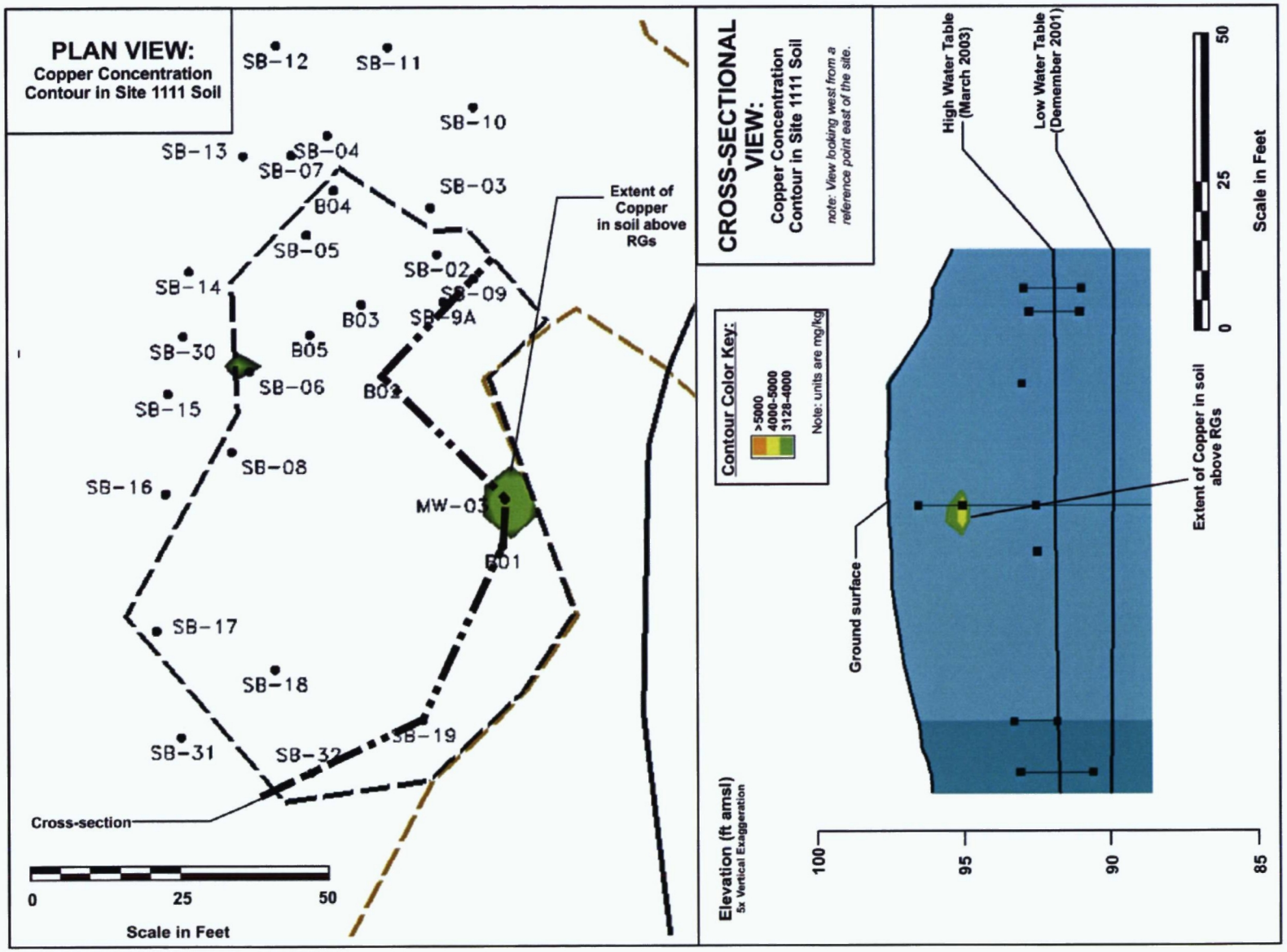

PLAN VIEW:
DDT Concentration
Contour in Site 1111 Soil
SB-12
SB-11
SB-10
SB-13
SB-04
SB-07
SB-03
SB-05
SB-02
SB-14
SB-09
SB-9A
SB-30
B05
SB-06
SB-15
SB-08
SB-16
MW-03
SB-17
SB-18
SB-19
SB-31
SB-32
Extent of DDT in soil above RGs
Cross-section
0
25
50
Scale in Feet
CROSS-SECTIONAL VIEW:
DDT Concentration
Contour in Site 1111 Soil
note: View looking west from a reference point east of the site.
Contour Color Key:
>10000
5000-10000
1720-5000
Note: units are µg/kg
High Water Table (March 2003)
Low Water Table (Demember 2001)
Ground surface
Extent of DDT in soil above Rgs
Elevation (ft amsl)
5x Vertical Exaggeration
100
95
90
85
0
25
50
Scale in Feet

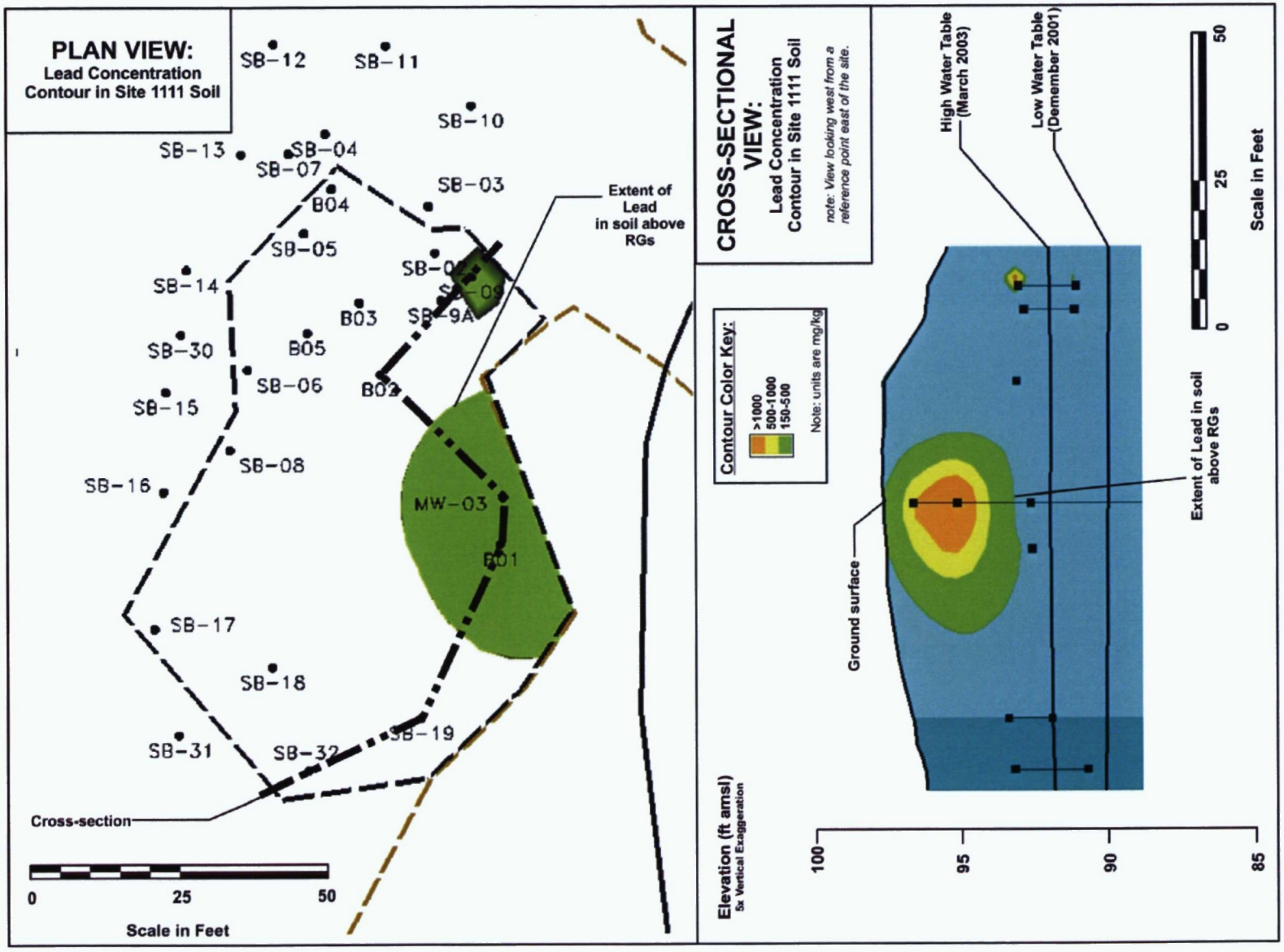

PLAN VIEW:
Antimony Concentration Contour in Site 1111 Soil
SB-12
SB-11
SB-10
SB-13
SB-04
SB-07
SB-03
B04
SB-05
SB-02
SB-14
SB-09
B03
SB-9A
SB-30
B05
SB-06
B02
SB-15
SB-08
SB-16
MW-03
B01
SB-17
SB-18
SB-19
SB-31
SB-32
Extent of Antimony in soil above RGs
Cross-section
0
25
50
Scale in Feet
CROSS-SECTIONAL VIEW:
Antimony Concentration Contour in Site 1111 Soil
note: View looking west from a reference point east of the site.
Contour Color Key:
>500
100-500
12-100
Note: units are mg/kg
High Water Table (March 2003)
Low Water Table (Demember 2001)
Ground surface
Extent of Antimony in soil above RGs
0
25
50
Scale in Feet
Elevation (ft amsl)
5x Vertical Exaggeration
100
95
90
85

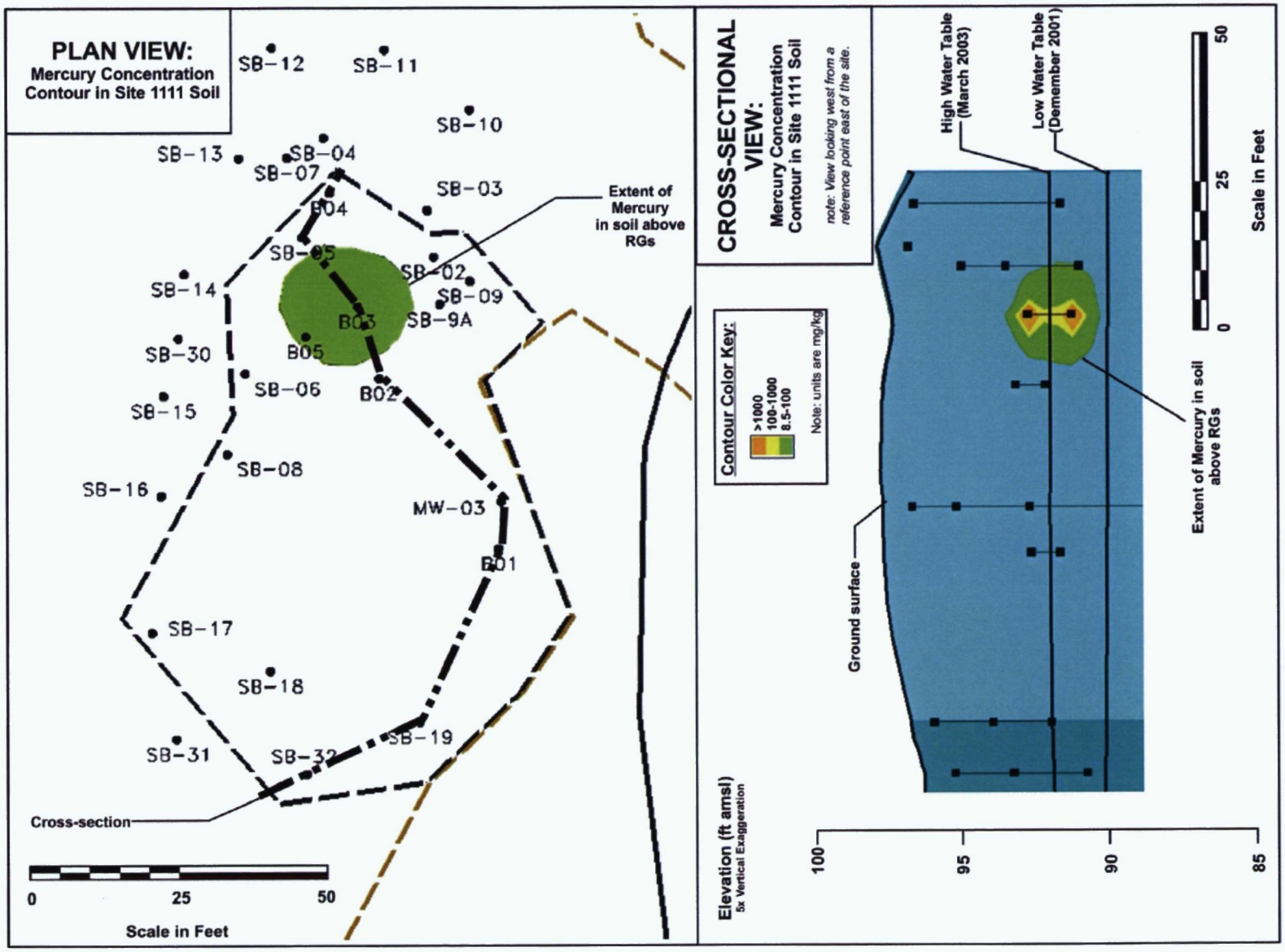

PLAN VIEW:
Arsenic Concentration Contour in Site 1111 Soil
SB-12
SB-11
SB-10
SB-13
SB-04
SB-07
SB-03
B04
SB-05
SB-02
SB-14
SB-09
B03
SB-9A
SB-30
B05
SB-06
B02
SB-15
SB-08
SB-16
MW-03
B01
SB-17
SB-18
SB-31
SB-32
SB-19
Cross-section
Extent of Arsenic in soil above RGs
0
25
50
Scale in Feet
CROSS-SECTIONAL VIEW:
Arsenic Concentration Contour in Site 1111 Soil
note: View looking west from a reference point east of the site.
Contour Color Key:
>20
10-20
4.6-10
Note: units are mg/kg
High Water Table (March 2003)
Low Water Table (Demember 2001)
Ground surface
Extent of Arsenic in soil above RGs
0
25
50
Scale in Feet
Elevation (ft amsl)
5x Vertical Exaggeration
100
95
90
85


PLAN VIEW:
Cadmium Concentration Contour in Site 1111 Soil
SB-12
SB-11
SB-10
SB-13
SB-04
SB-07
SB-03
B04
SB-05
SB-02
SB-14
SB-09
B03
SB-9A
SB-30
B05
SB-06
B02
SB-15
SB-08
SB-16
MW-03
B01
SB-17
SB-18
SB-19
SB-31
SB-32
Extent of Cadmium in soil above RGs
Cross-section
0
25
50
Scale in Feet
CROSS-SECTIONAL VIEW:
Cadmium Concentration Contour in Site 1111 Soil
note: View looking west from a reference point east of the site.
Contour Color Key:
>5
2-5
1.6-2
Note: units are mg/kg
High Water Table (March 2003)
Low Water Table (Demember 2001)
Ground surface
Extent of Cadmium in soil above RGs
0
25
50
Scale in Feet
Elevation (ft amsl)
5x Vertical Exaggeration
100
95
90
85


PLAN VIEW:
Chromium (VI) Concentration Contour in Site 1111 Soil
SB-12
SB-11
SB-10
SB-13
SB-04
SB-07
SB-03
B04
SB-05
SB-02
SB-09
SB-14
B03
SB-9A
SB-30
B05
SB-06
B02
SB-15
SB-08
SB-16
MW-03
B01
SB-17
SB-18
SB-31
SB-32
SB-19
Extent of Chromium (VI) in soil above RGs
Cross-section
0
25
50
Scale in Feet
CROSS-SECTIONAL VIEW:
Chromium (VI) Concentration Contour in Site 1111 Soil
note: View looking west from a reference point east of the site.
Contour Color Key:
>20
18-20
16.29-20
Note: units are mg/kg
High Water Table (March 2003)
Low Water Table (Demember 2001)
Ground surface
Extent of Chromium (VI) in soil above RGs
0
25
50
Scale in Feet
Elevation (ft amsl)
5x Vertical Exaggeration
100
95
90
85


PLAN VIEW:
Copper Concentration Contour in Site 1111 Soil
SB-12
SB-11
SB-10
SB-13
SB-04
SB-07
SB-03
B04
SB-05
SB-02
SB-14
SB-09
B03
SB-9A
SB-30
B05
SB-06
B02
SB-15
SB-08
SB-16
MW-03
B01
SB-17
SB-18
SB-31
SB-32
SB-19
Cross-section
Extent of Copper in soil above RGs
0
25
50
Scale in Feet
CROSS-SECTIONAL VIEW:
Copper Concentration Contour in Site 1111 Soil
note: View looking west from a reference point east of the site.
Contour Color Key:
>5000
4000-5000
3128-4000
Note: units are mg/kg
High Water Table (March 2003)
Low Water Table (Demember 2001)
Ground surface
Extent of Copper in soil above RGs
Elevation (ft amsl)
5x Vertical Exaggeration
100
95
90
85
0
25
50
Scale in Feet


PLAN VIEW:
Lead Concentration
Contour in Site 1111 Soil
SB-12
SB-11
SB-10
SB-13
SB-04
SB-07
SB-03
B04
SB-05
SB-14
B03
SB-9A
SB-30
B05
SB-06
B02
SB-15
SB-08
SB-16
MW-03
B01
SB-17
SB-18
SB-19
SB-31
SB-32
Extent of Lead in soil above RGs
Cross-section
0
25
50
Scale in Feet
CROSS-SECTIONAL VIEW:
Lead Concentration Contour in Site 1111 Soil
note: View looking west from a reference point east of the site.
Contour Color Key:
>1000
500-1000
150-500
Note: units are mg/kg
High Water Table (March 2003)
Low Water Table (Demember 2001)
Ground surface
Extent of Lead in soil above RGs
Elevation (ft amsl)
5x Vertical Exaggeration
100
95
90
85
0
25
50
Scale in Feet


PLAN VIEW:
Mercury Concentration Contour in Site 1111 Soil
SB-12
SB-11
SB-10
SB-13
SB-04
SB-07
SB-03
B04
Extent of Mercury in soil above RGs
SB-05
SB-02
SB-14
SB-09
B03
SB-9A
SB-30
B05
SB-06
B02
SB-15
SB-08
SB-16
MW-03
B01
SB-17
SB-18
SB-31
SB-32
SB-19
Cross-section
0
25
50
Scale in Feet
CROSS-SECTIONAL VIEW:
Mercury Concentration Contour in Site 1111 Soil
note: View looking west from a reference point east of the site.
Contour Color Key:
>1000
100-1000
8.5-100
Note: units are mg/kg
High Water Table (March 2003)
Low Water Table (Demember 2001)
Ground surface
Extent of Mercury in soil above RGs
0
25
50
Scale in Feet
Elevation (ft amsl)
5x Vertical Exaggeration
100
95
90
85